# A MECHANICAL COURSE FOR HIGH SCHOOLS

BY

ROBERT A. PERKINS

ARMOUR INSTITUTE OF TECHNOLOGY

1917

# A MECHANICAL COURSE FOR HIGH SCHOOLS

A THESIS

PRESENTED BY

ROBERT AUGUSTUS PERKINS

TO THE

PRESIDENT AND FACULTY

OF

ARMOUR INSTITUTE OF TECHNOLOGY

FOR THE DEGREE OF

MASTER OF SCIENCE

IN

INDUSTRIAL ARTS

MAY 31, 1917



APPROVED:

Dean of Engineering Studies

Dean of Cultural Studies

Object.

It is not the expectation of adding materially to the subject matter already in the possession of the instructor of industrial education that has led the author to undertake this work. It is rather that, in his own experience as a teacher, he has felt the lack of standardization, correlation, and progression of the subjects commonly presented and generally recognized as an essential to a pre-vocational or industrial education and has collected in these pages the results of his efforts to re-arrange and unify.

Four distinct and completely outlined courses, from the ninth up to and including the thirteenth year, are herewith submitted. They are designed to meet the needs of all boys in the school systems who are mechanically inclined and it is the author's hope that, if

closely followed, they will prove more efficient than courses chosen at random however excellent the individual texts.

The first outlined is the "General Trade Course" for boys who, in after life, will wish to enter some one of the trades. Upon completion of the work specified it is the author's idea that a diploma should be awarded as in all other courses, but that it should be designated as "non-accredited".

The second is that entitled the "Manual Training Course" for those lads who may, or may not, wish to enter college, but who feel that, whatever may be their after life, a slight general knowledge of the Manual Arts will be of value.

The "Preparatory Architectural" and the "Preparatory Engineering" represent respectively the third and fourth courses outlined and are for those students who intend to pursue a technical education after graduation

from High school.

In regard to the last mentioned purpose it is important to understand that, owing to the insistent demand of the engineering colleges for better preparation on the part of students entering and graduating from their various departments, it is advisable for all who enter technical schools to [illegible] as many advanced credits as possible. It is obvious that the time thus gained makes it possible to give much more attention to the purely technical subjects of the college curriculum, with the result that men of greater efficiency leave these institutions for active professional life. With this object in view the "Preparatory Architectural" and "Engineering" courses have been designed providing for one year of graduate work.

Believing that [illegible] is shown in an il-

lustration makes a stronger, more lasting, and more accurate impression upon the mind of the pupil than any written description or explanation could possibly do, the author has used drawings wherever possible and has eliminated the written text. There is a two-fold advantage in this for, without his knowledge, perhaps, the student will attempt to bring his own style to the standard set by the plates which he studies.

The illustrations in Book No.1 of this work are reproductions of drawings made by pupils in the D4A and D5-6M classes conducted by the author and represent what, in his opinion, should be expected of "A class" pupils.

R.A.P.

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LIST OF ILLUSTRATIONS
-OF-
[illegible]

(All [illegible])

LIST OF ILLUSTRATIONS. (Continued)

9

## TABULAR VIEW OF COMPLETE COURSES.

### GENERAL TRADE COURSE.

#### First Year.

First Semester:-

| | |
|---|---|
| | English |
| | Biology or Botany |
| Course No.S1 | Bench Work (2 Periods Daily) |
| Course No.D1 | Mech Drawing (2 Periods Daily) |
| | Free-hand Dr. (4 Periods Weekly) |

Second Semester:-

| | |
|---|---|
| | English |
| | Physiology or Botany |
| Course No.S2 | Bench Work (2 Periods Daily) |
| Course No.D2. | Mech. Drawing (2 Periods Daily) |
| | Free-hand Dr. (4 Periods Weekly) |

#### Second Year.

First Semester:-

| | |
|---|---|
| | English |
| | Advanced Arithmetic (Commercial) |
| Course No.S3 | Wood Turning (2 Periods Daily) |
| Course No.D3 | Mechanical Dr. (2 Periods Daily) |
| | Free-hand Dr. (4 Periods Weekly) |

Second Semester:-

| | |
|---|---|
| | English |
| | Advanced Arithmetic (Commercial) |
| Course No.S4 | Pattern Making (2 Periods Daily) |
| Course No D4 | Mech. Drawing (2 Periods Daily) |
| | Free-hand Dr. (4 Periods Weekly) |

A Mechanical Course For High Schools.

GENERAL TRADE COURSE (Continued)

Third Year.

First Semester:-

| | |
|---|---|
| | English |
| | Algebra |
| Course No.S5 | Forge Shop (2 Periods Daily) |
| Course No.D5 | Mech. Drawing (2 Periods Daily) |
| | Free-hand Dr. (4 Periods Weekly) |

Second Semester:-

| | |
|---|---|
| | English |
| | Algebra |
| Course No.S6 | Foundry (2 Periods Daily) |
| Course No.D6 | Mech. Drawing (2 Periods Daily) |
| | Free-hand Dr. (4 Periods Weekly) |

Fourth Year.

First Semester:-

| | |
|---|---|
| | Geometry |
| Course No.S7 | Machine Shop (4 Periods Daily) |
| | Elect One |
| | Chemistry |
| | Physics |
| | American History and Civics |
| | English, French or German. |

Second Semester:-

| | |
|---|---|
| | Geometry |
| Course No.S8 | Shop (4 Periods Daily) |
| | Continue Elective of First Semester. |

A Mechanical Course For High Schools.

GENERAL TRADE COURSE (Continued)

Fifth Year.

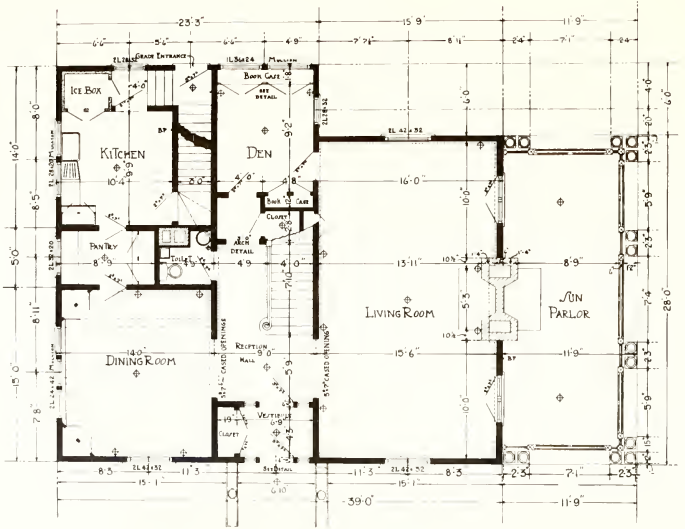
First Semester:-

Course No.59 Shop (4 Periods Daily)
Course No.D7M Mech. Drawing and Mathematics
of Course No.59 (2 Periods Daily)
Elective:
Chemistry
Physics
American History and Civics
English, French or German.

Second Semester:-

Course No.59 Continued (4 Periods Daily)
Course No.D7M Continued (2 Periods Daily)
Continue Elective of First Semester.

NOTE.- In this course, where it is possible to do so, the pupils should have their English, Mathematics, Science, Civil Government, and History in classes by themselves in order that their instructors may so outline and present the subjects that they will always directly apply to the future industrial life of the boy. Special short courses should be arranged for, from the subject matter herein presented, to accommodate those who, through pressure of circumstances, must begin earning as soon as possible and these courses should be selected with the idea that underlying principles rather than technique are of first importance.




A MECHANICAL COURSE FOR HIGH SCHOOLS
BY ROBERT A. PERKINS.

| | | |
|---|---|---|
| PLATE NO. 1 | FRAME COLONIAL RESIDENCE for MR. JOHN SMITH SIOUX FALLS SO. DAK. | DRAWN BY HAROLD T. SPITZNAGEL |

A Mechanical Course For High Schools.

MANUAL TRAINING COURSE.

First Year.

First Semester:-

| | |
|---|---|
| | English |
| | Algebra |
| | Physiography |
| Course No.D1 | Mech. Drawing (2 Periods Daily) |
| | Free-hand Dr. (4 Periods Weekly) |

Second Semester:-

| | |
|---|---|
| | English |
| | Algebra |
| Course No.S1 | Bench Work (2 Periods Daily) |
| | Free-hand Dr. (4 Periods Weekly) |
| | Physiography |

Second Year.

First Semester:-

| | |
|---|---|
| | English |
| | Geometry |
| | History |
| Course No.D2 | Mech. Drawing (2 Periods Daily) |
| | Free-hand Dr. (4 Periods Weekly |

Second Semester:-

| | |
|---|---|
| | English |
| | Geometry |
| | History |
| Course No.S3 | Wood Turning (2 Periods Daily) |
| | Free-hand Dr. (4 Periods Weekly) |

A Mechanical Course For High Schools.

MANUAL TRAINING COURSE (Continued)

Third Year.

First Semester:-

| | |
|---|---|
| | English |
| | Algebra |
| | Physics |
| Course No.D5 | Mech. Drawing (2 Periods Daily) |
| | Art Work (4 Periods Weekly) |

Second Semester:-

| | |
|---|---|
| | English |
| | Algebra |
| | Physics |
| Course No.S5 | Forge Shop (2 Periods Daily) |
| | Art Work (4 Periods Weekly) |

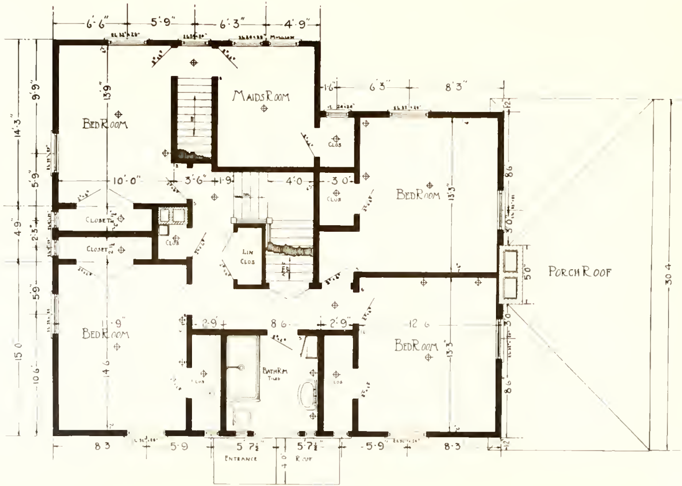
Fourth Year.

First Semester:-

| | |
|---|---|
| | English |
| | Solid Geometry |
| | Chemistry |
| Course No.D4 | Mech. Drawing (2 Periods Daily) |
| | Art Work (4 Periods Weekly) |

Second Semester:-

| | |
|---|---|
| | English |
| | Trigonometry |
| | Chemistry |
| Course No.S6 | Foundry (2 Periods Daily) |
| | Art Work (4 Periods Weekly) |




A MECHANICAL COURSE FOR HIGH SCHOOLS
BY ROBERT A. PERKINS.

| | | |
|---|---|---|
| PLATE NO. 2 | FRAME COLONIAL RESIDENCE for MR JOHN SMITH SIOUX FALLS SO. DAK | DRAWN BY HAROLD T. SPITZNAGEL |

A Mechanical Course For High Schools.

PREPARATORY ARCHITECTURAL COURSE.

First Year.

First Semester:-

| | |
|---|---|
| | English |
| | Algebra |
| | Greek History |
| Course No.S1 | Bench Work (2 Periods Daily) |
| | Art Work (4 Periods Weekly) |

Second Semester:-

| | |
|---|---|
| | English |
| | Algebra |
| | Roman History |
| Course No.D1 | Mech. Drawing (2 Periods Daily) |
| | Art Work (4 Periods Weekly) |

Second Year.

First Semester:-

| | |
|---|---|
| | English |
| | Geometry |
| Course No.S2. | Bench Work (2 Periods Daily) |
| | French or German |
| | Art Work (4 Periods Weekly) |

Second Semester:-

| | |
|---|---|
| | English |
| | Geometry |
| Course No.D2 | Mech. Drawing (2 Periods Daily) |
| | French or German |
| | Art Work (4 Periods Weekly) |

A Mechanical Course For High Schools.

PREPARATORY ARCHITECTURAL COURSE (Continued)

Third Year.

First Semester:-

English
Algebra
Course No.D3 Mechanical Dr. (2 Periods Daily)
French or German
Art Work (4 Periods Weekly)

Second Semester:-

English
College Algebra
Course No.D4 Architectural Drawing (2 PeriodsDaily)
French or German
Art Work (4 Periods Weekly)

Fourth Year.

First Semester:-

English
Trigonometry
Physics
Course No.D5 Architectural Dr. (2 Periods Daily)
Art Work (4 Periods Weekly)

Second Semester:-

English
Trigonometry
Physics
Course No.D6 Architectural Dr. (2 Periods Daily)
Art Work (4 Periods Weekly)

A Mechanical Course For High Schools.

PREPARATORY ARCHITECTURAL COURSE (Continued

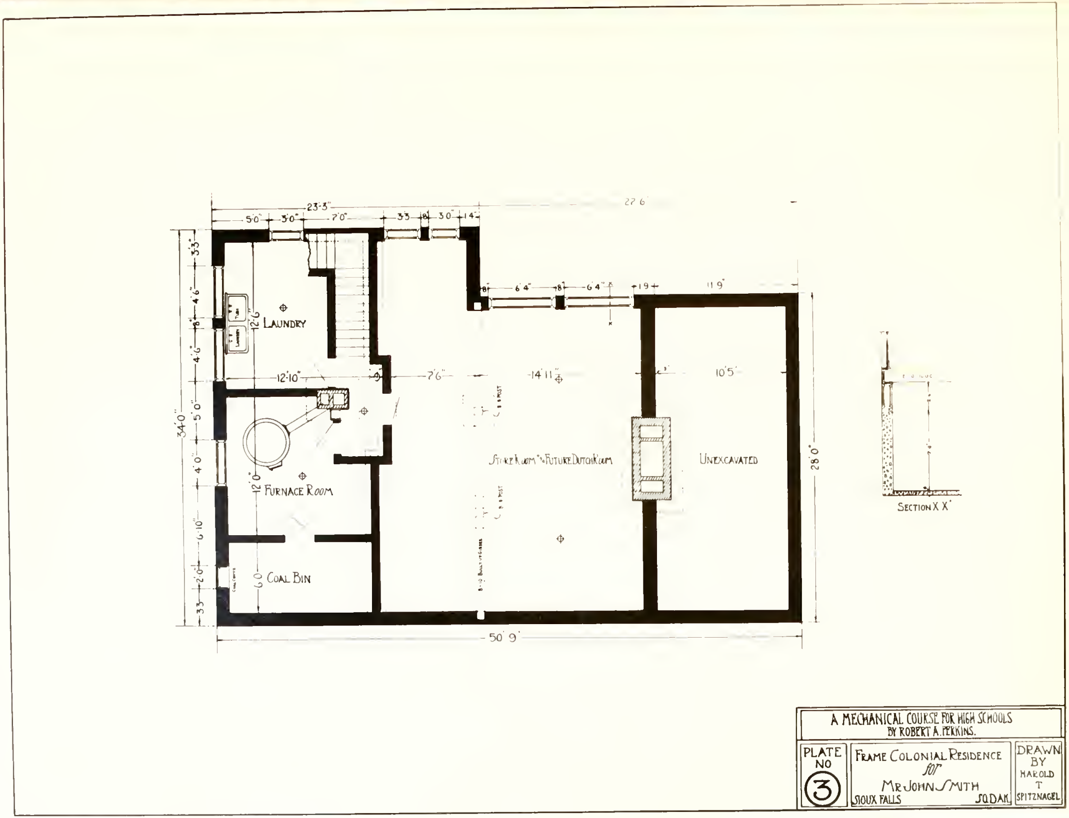
Graduate Year.

First Semester:-

| | |
|---|---|
| | Descriptive Geometry (2 Periods Daily) |
| Course No.D7 | Architectural Dr. (4 Periods Daily) |
| | Chemistry (General) |
| | Art Work (4 Periods Weekly) |

Second Semester:-

| | |
|---|---|
| | Descriptive Geom. (2 Periods Daily) |
| Course No.D8 | Architectural Dr. (4 Periods Daily) |
| | Chemistry (General). |
| | Art Work (4 Periods Weekly) |



23'3"
27'6"
5'0"
3'0"
7'0"
3'3"
8"
3'0"
1'4"
6'4"
8"
6'4"
1'9"
11'9"
34'0"
3'3"
4'6"
8"
4'6"
5'0"
4'0"
6'10"
2'0"
12'6"
12'10"
7'6"
14'11"
10'5"
28'0"
12'0"
6'0"
50'9"
LAUNDRY
FURNACE ROOM
COAL BIN
STORE ROOM & FUTURE DUTCH ROOM
UNEXCAVATED
SECTION X X'
A MECHANICAL COURSE FOR HIGH SCHOOLS
BY ROBERT A. PERKINS.
PLATE NO 3
FRAME COLONIAL RESIDENCE
for
MR JOHN SMITH
SIOUX FALLS
SO. DAK.
DRAWN BY HAROLD T SPITZNAGEL

A Mechanical Course For High Schools.

PREPARATORY ENGINEERING COURSE.

First Year.

First Semester:-

English
Algebra
Greek History
Course No.D1 Mech Drawing (2 Periods Daily)
Free-hand Dr. (4 Periods Weekly)

Second Semester:-

English
Algebra
Roman History
Course No.S1 Bench Work (2 Periods Daily)
Free-hand Dr. (4 Periods Weekly)

Second Year.

First Semester:-

English
Geometry
Course No.D2 Mech. Drawing (2 Periods Daily)
German or French
Free-hand Dr. (4 Periods Weekly)

Second Semester:-

English
Geometry
Course No.S3 Turning & Pattern Making (2 Periods Daily)
German or French
Free-hand Dr. (4 Periods Weekly)

A Mechanical Course For High Schools.

PREPARATORY ENGINEERING COURSE (Continued)

Third Year.

First Semester:-

| | |
|---|---|
| | English |
| | Algebra |
| | Physics |
| Course No.D3 | Mech. Drawing (2 Periods Daily) |
| | German or French |

Second Semester:-

| | |
|---|---|
| | English |
| | College Algebra |
| | Physics |
| Course No.S5 | Forge Shop (2 Periods Daily) |
| | German or French |

Fourth Year.

First Semester:-

| | |
|---|---|
| | English |
| | Solid Geometry |
| | Chemistry |
| Course No.D4 | Mech. Drawing (2 Periods Daily) |
| | Economics |

Second Semester:-

English
Plane Trigonometry
(Note) If the graduate year is taken, Shop S4 will be substituted for Trigonometry in this semester.

A Mechanical Course For High Schools.

PREPARATORY ENGINEERING COURSE (Continued)

| | |
|---|---|
| | Chemistry |
| Course No.S6 | Foundry (2 Periods Daily) |
| | Economics |

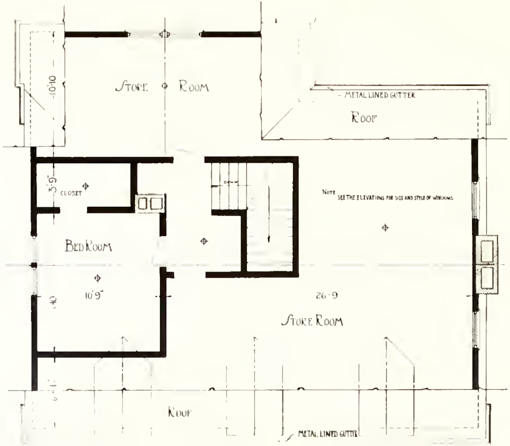
Graduate Year.

First Semester:-

| | |
|---|---|
| | Descriptive Geom. (2 Periods Daily) |
| Course No.D5 | Mech. Drawing (2 Periods Daily) |
| Course No.S7 | Machine Shop (2 Periods Daily) |
| | Plane Trig. (1 Period Daily) |

Second Semester:-

| | |
|---|---|
| | Descriptive Geom. (2 Periods Daily) |
| Course No.D6 | Mech.Drawing (2 Periods Daily) |
| Course No.S8 | Machine Shop (2 Periods Daily) |
| | Analytical Geom. or Scientific German or French. |




A MECHANICAL COURSE FOR HIGH SCHOOLS
BY ROBERT A. PERKINS.

| PLATE NO 4 | FRAME COLONIAL RESIDENCE for MR. JOHN SMITH SIOUX FALLS SO. DAK. | DRAWN BY HAROLD SPITZNAGEL |
|---|---|---|

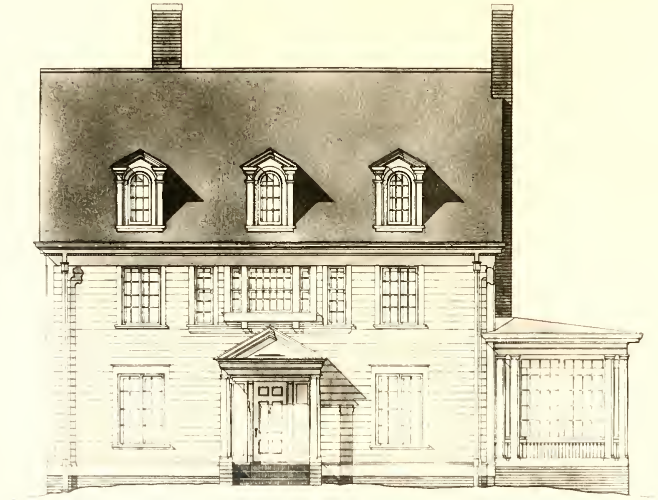
A Mechanical Course For High Schools.

-Outline of-

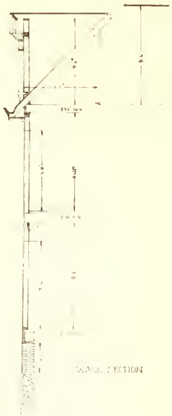
MECHANICAL DRAWING COURSES.

<u>Course D1.</u>

Plates Nos. 1 and 2 in lettering are designed to give the student an idea of the letter and figure forms most commonly employed in practical office work and some facility in their use. Plates Nos. 3,4, and 5 are in geometrical constructions and fill the two-fold purpose of affording exercises in which to become familiar with the use of instruments and of impressing the pupil with the need of accuracy and neatness in his work. The last four plates, Nos. 6,7,8, and 9, are in furniture design and cover the exercises to be executed in shop Course No. S1. Not less than one hundred and fifty words, exclusive of titles and name plates are to accompany each plate. This lettering is to be in explanation of the problems



ELEVATION



SECTION

A MECHANICAL COURSE FOR HIGH SCHOOLS
BY ROBERT A PERKINS.

| | | |
|---|---|---|
| PLATE NO 5 | FRAME COLONIAL RESIDENCE for MR JOHN SMITH SIOUX FALLS SO DAK | DRAWN BY HAROLD T SPITZNAGEL |

and in answer to the questions accompanying them. This lettering is to be done as home work, upon quarter size plates, and attached by clips to the main plate when it is submitted for correction.

Course D2.

Plate No.1 in line or stipple shading of surfaces, is to be practiced until gradations can be made smoothly. The first turning exercises, of Course No.S3 are designed and rendered in this plate. Plate No.2 in graded washes, is the design of the built-up pulley pattern, pilot wheel, or hand wheel, one of which is to be selected as the last exercise of Course No. S3. (Note:- Cuts of a few of these models made in the author's classes are included in this text) Plate No.3 is the design of the main project for shop Course No.S2 and is to be worked out by the pupil from some cabinet

North Elevation

A MECHANICAL COURSE FOR HIGH
BY ROBERT A. PERKINS.

PLATE NO 6

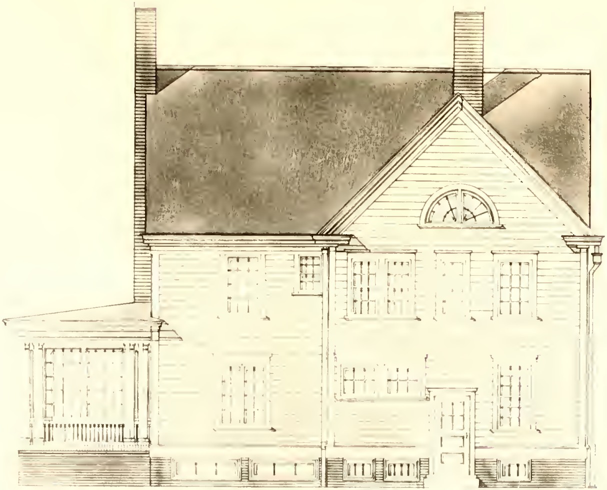
FRAME COLONIAL RESIDENCE
for
MR JOHN SMITH
SIOUX FALLS SO DAK

RAWN BY
T
SPITZNAGEL

he has seen and wishes to duplicate or it may be an original idea which is acceptable to the instructor. Plates 4 to 9, inclusive, are in orthographic projections, explaining the theory of lines, true length and fore-shortened, development of surfaces, and beginning penetrations. The surfaces are to be rendered in flat washes where specified. The same amount of lettering must accompany each plate in this course as is specified for Course D1.

Course D3.

Plates Nos. 1 and 2 cover the design of the exercises for forge shop S5. and give the student, at the same time, his first experience in the conventions employed in the design of simple steel pieces. Plates Nos. 3 to 9, inclusive, are in penetrations and developments of surfaces, showing traces of intersections, and are to be rendered in washes or in line shading where specified. All developments are to be cut from heavy paper or light sheet



East Elevation

A MECHANICAL COURSE FOR HIGH SCHOOLS
BY ROBERT A PERKINS

PLATE No 7

FRAME COLONIAL RE...

MR JOHN SMITH

SIOUX FALL...

metal with the area within the line of intersection removed from one surface and the trace of intersection left upon the other. When the two surfaces are placed together in the required position, the pupil will have a mechanical demonstration of the accuracy of his drawing. Lettering requirements are the same as in D1. and D2. At this point the mechanical drawing is divided into the two departments of "Preparatory Engineering" and "Preparatory Architecture"; it being optional with students of the "General Trade" and "Manual Training" Courses which of these they will pursue.

South Elevation

| | | |
|---|---|---|
| A Mechanical Course for High Schools<br>by Robert A Perkins | | |
| Plate No 8 | Frame Colonial Residence for Mr John Smith<br>Sioux Falls So Dak | Drawn by Harold T Spitznagel |

A Mechanical Course For High Schools.

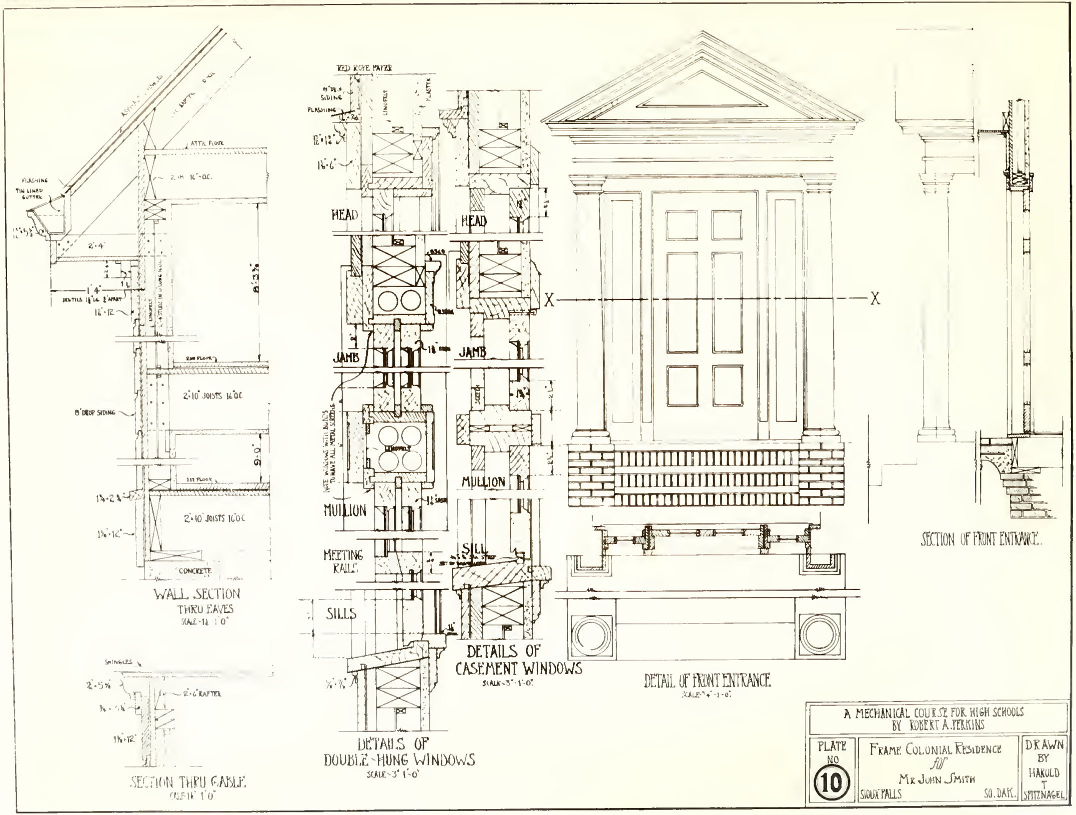
-Outline of-

ARCHITECTURAL DRAWING COURSES.

Course D4A.

Eleven plates in residence design represent the assignment for this course consisting of Plates 1 to 4, floor plans, 5 to 8, the elevations, and 8 to 11, the wall sections and interior and exterior details. An idea of the scope of the course may be obtained by reference to the first twelve plates included herewith.

The object of this course will have been accomplished if the student has acquired a knowledge of the rudiments of building framing, the principles of representation employed in making building plans, and the ability to interpret correctly a set of not too complicated building plans when they are placed before him.



FLASHING
TIN LINED GUTTER
ATTIC FLOOR
2'-4"
1'-4"
DENTILS 1½" LG 2" APART
1⅝"-12
2ND FLOOR
2"-10" JOISTS 16" O.C.
8" DROP SIDING
9'-0"
1ST FLOOR
2"-10" JOISTS 16" O.C.
CONCRETE
WALL SECTION
THRU EAVES
SCALE-1½"-1'-0"
SHINGLES
2"-6" RAFTER
SECTION THRU GABLE
RED ROPE PAPER
8" DR. SIDING
FLASHING
LINOFELT
PLASTER
HEAD
JAMB
MULLION
MEETING RAILS
SILLS
NOTE WINDOWS WITH BLINDS TO HAVE ALL METAL SCREENS
DETAILS OF
DOUBLE-HUNG WINDOWS
SCALE-3"-1'-0"
HEAD
JAMB
MULLION
SILL
DETAILS OF
CASEMENT WINDOWS
SCALE-3"-1'-0"
X
X
DETAIL OF FRONT ENTRANCE
SECTION OF FRONT ENTRANCE.
A MECHANICAL COURSE FOR HIGH SCHOOLS
BY ROBERT A. PERKINS
PLATE NO 10
FRAME COLONIAL RESIDENCE
for
MR JOHN SMITH
SIOUX FALLS SO. DAK.
DRAWN BY HAROLD T SPITZNAGEL

A Mechanical Course for High Schools.

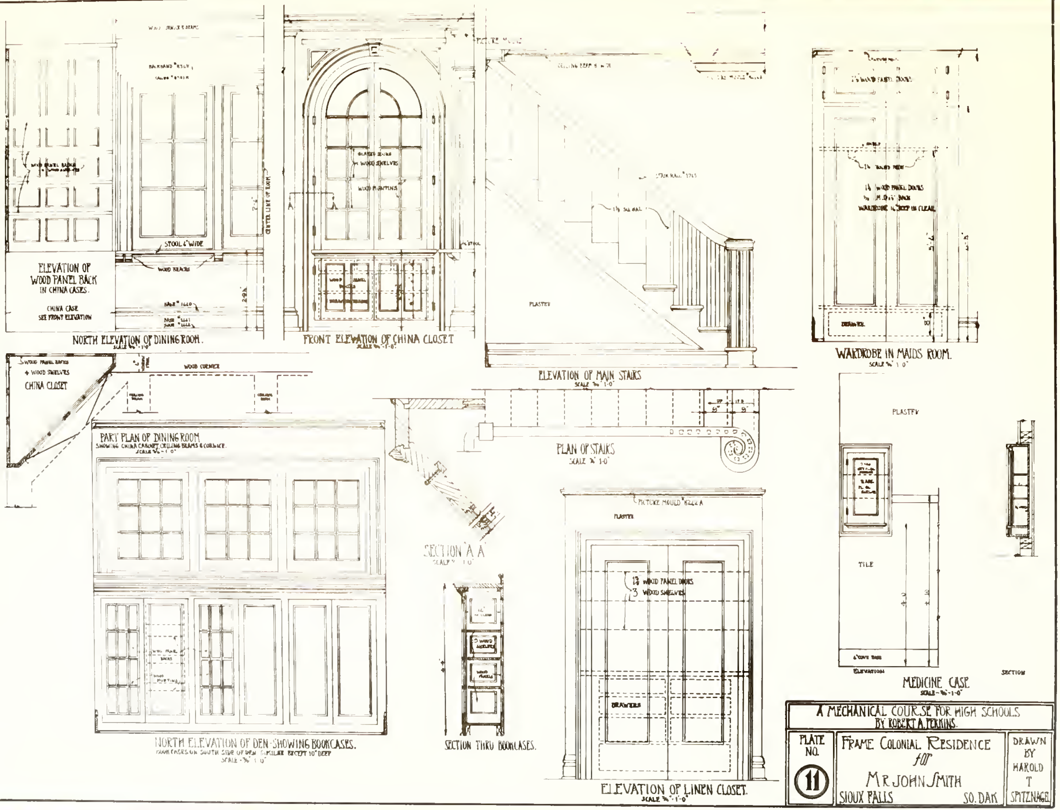
Lettering is as in the preceding courses.

Course D5A.

Plates 1 to 8, inclusive, in this course deal with the two most used forms of perspective construction, viz. the "Office Method" and the "Distance Point Method". Problems involving the perspective of simple arrangements of geometrical solids are first employed. These are increased in difficulty as the course progresses, until the final problem, which is the perspective of the residence designed in Course D4A and comprises the whole of Plate 9 See Plate No.9, page .1..... ...) Lettering as before specified.

Course D6A.

Nine plates are included in this course covering the following subject matter: First, the shadow of objects in perspective with the rays of light parallel to the picture plane:



A MECHANICAL COURSE FOR HIGH SCHOOLS
BY ROBERT A. PERKINS.

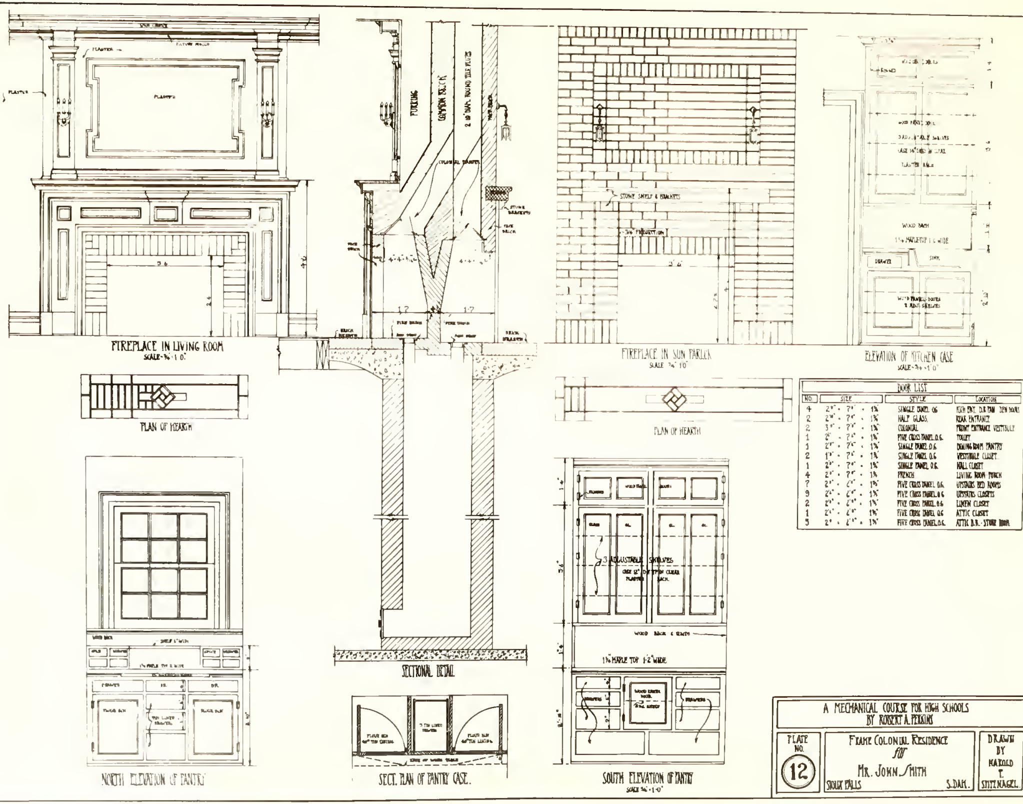
PLATE NO. 11

FRAME COLONIAL RESIDENCE
for
MR JOHN SMITH
SIOUX FALLS SO. DAK

DRAWN BY HAROLD T SPITZNAGEL

second, with the source of light in front of the observer; and third, with the source of light behind the observer. Three plates are given to this, the fourth plate consisting of the laying out of shadows and complete rendering of plate No.9, Course D6A. Plates 5 to 8 are given up to shades and shadows in interior perspective and plate No.9 is designed to introduce a few of the principles of reflections.

All shadows are to be laid out with extreme care and the drawings rendered in water color. It is in this and the succeeding courses especially that the value of the four years of art called for in the "Preparatory Architectural Course" is shown, for the beauty of the drawings will be to a great extent dependant upon the ability to use colors effectively. Letter-




DOOR LIST

| NO. | SIZE | STYLE | LOCATION |
|---|---|---|---|
| 4 | 2'8" × 7'0" × 1⅜" | SINGLE PANEL O.G. | KITCH ENT. D.R. PAN. DEN DOORS |
| 2 | 2'10" × 7'0" × 1⅜" | HALF GLASS. | REAR ENTRANCE |
| 2 | 3'0" × 7'0" × 1⅜" | COLONIAL | FRONT ENTRANCE VESTIBULE |
| 1 | 2'6" × 7'0" × 1⅜" | FIVE CROSS PANEL O.G. | TOILET |
| 1 | 2'8" × 7'0" × 1⅜" | SINGLE PANEL O.G. | DINING ROOM PANTRY |
| 2 | 1'9" × 7'0" × 1⅜" | SINGLE PANEL O.G. | VESTIBULE CLOSET |
| 1 | 2'0" × 7'0" × 1⅜" | SINGLE PANEL O.G. | HALL CLOSET |
| 4 | 2'0" × 7'0" × 1⅜" | FRENCH | LIVING ROOM PORCH |
| 7 | 2'8" × 6'8" × 1⅜" | FIVE CROSS PANEL O.G. | UPSTAIRS BED ROOMS |
| 9 | 2'6" × 6'8" × 1⅜" | FIVE CROSS PANEL O.G. | UPSTAIRS CLOSETS |
| 2 | 2'0" × 6'8" × 1⅜" | FIVE CROSS PANEL O.G. | LINEN CLOSET |
| 1 | 2'6" × 6'0" × 1⅜" | FIVE CROSS PANEL O.G. | ATTIC CLOSET |
| 3 | 2'0" × 6'0" × 1⅜" | FIVE CROSS PANEL O.G. | ATTIC B.R. - STORE ROOM |

A MECHANICAL COURSE FOR HIGH SCHOOLS
BY ROBERT A. PERKINS

PLATE NO. 12

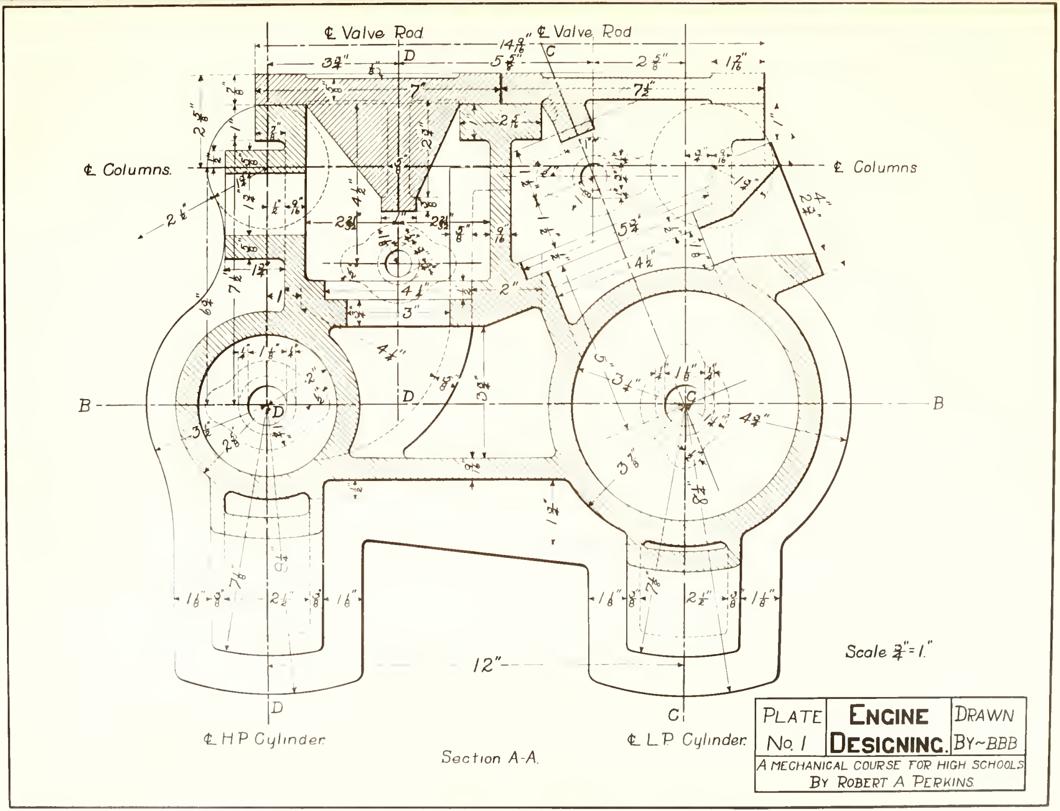
FRAME COLONIAL RESIDENCE
FOR
MR. JOHN SMITH
SIOUX FALLS S. DAK.

DRAWN BY HAROLD T. STITZNAGEL.

ing as in previous courses.

<u>Course D7A.</u>

This course is given up to the study of shades and shadows and is introductory to Course D8A in the same subject. In deriving the lines of shade and of shadow in this preliminary course use is made of plans, elevations, and sections. The first five plates, ranging in difficulty from the derivation of the shade and shadow of the simplest geometrical solids up to those of the more or less complicated architectural details, should give the student's imagination the needed training for taking the short cuts explained in the following course. The last four plates of this course require the laying out of the shade and shadow upon the four elevations of D4A. These are to be rendered in flat washes of water color. Lettering as before specified.



℄ Valve Rod
℄ Valve Rod
℄ Columns.
℄ Columns
℄ H P Cylinder.
℄ L P Cylinder.
Section A-A.
Scale 3/4" = 1."
PLATE
No. 1
ENGINE
DESIGNING.
DRAWN
BY ~ BBB
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BY ROBERT A PERKINS.

A Mechanical Course For High Schools.

Course D8A.

Eight plates in continuation of Course D7A at the completion of which the student is supposed to be able to lay out the shade and shadow of vases, cornices, colums, etc., with but little reference to the plan or sectional views, the points being located upon the lines of shade and shadow directly through a knowledge of the forms of the surfaces producing and receiving the shade and the shadow. Critical cones and many other means which have been devised for expediting the work are explained in detail. Lettering as in other courses.

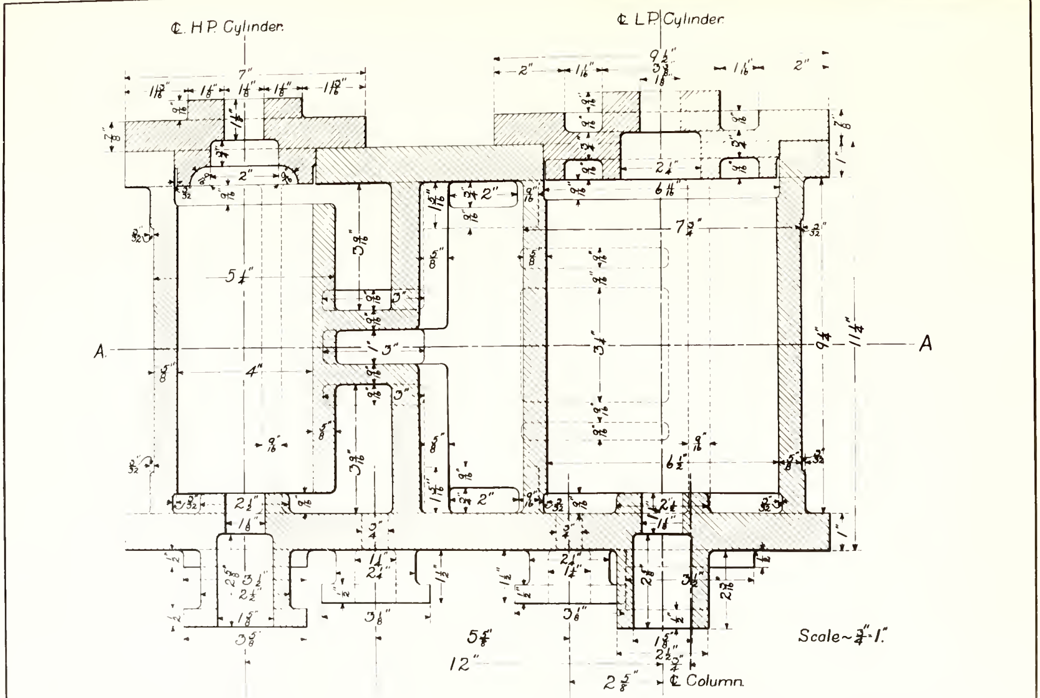


PLATE No. 2. ENGINE DESIGNING. DRAWN BY ~ BBB.

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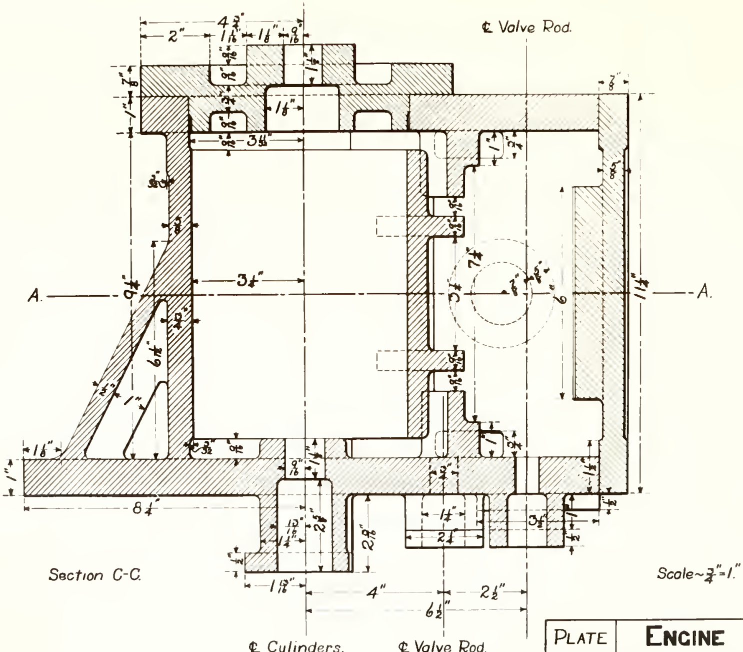
-Outline of-

PREPARATORY ENGINEERING DRAWING.

Course D4M.

The first three plates of this course are given to the introduction of the most important conventions of pure mechanical drawing. Some of the topics touched upon are: the development of the helix with its application to various types of threads, the types of bolts most used in machine construction, the design of nuts, and the theory of cross sectioning. In fact, they furnish the general data necessary to enter upon Course D5M. The last five plates of this semester's drawing the author has devoted to isometric projection, and, as in the course in perspective, begins with the construction of isometrics of simple geometrical solids. As the course progresses the problems are in-




| PLATE No. 3. | ENGINE DESIGNING. | DRAWN BY~BBB |
|---|---|---|

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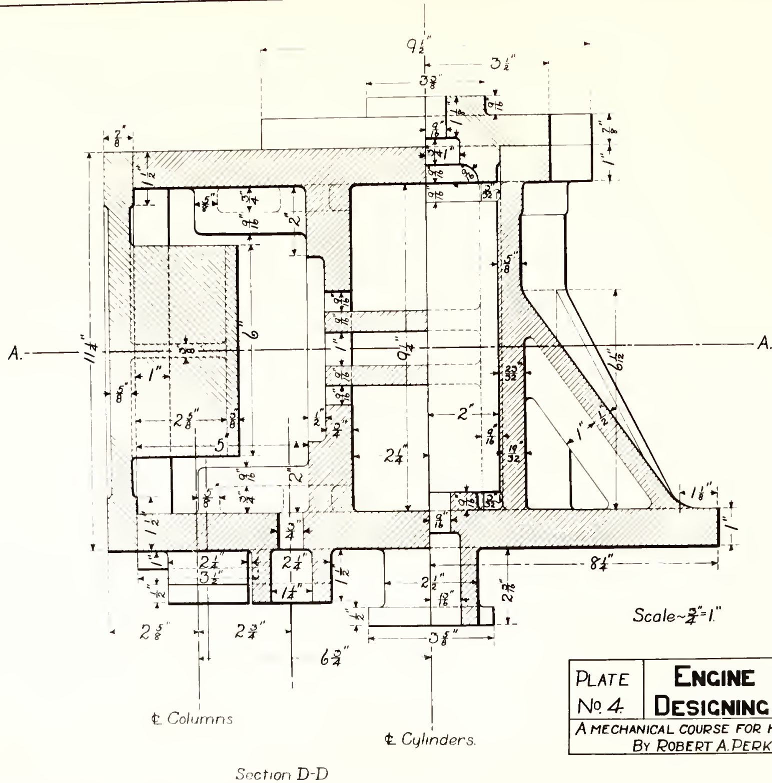
BY ROBERT A. PERKINS.

creased in difficulty until in the last two plates the drawings called for are of rather complicated machine parts. Special attention is to be paid to the lettering plates accompanying drawings.

<u>Course D5M.</u>

An idea of the quality of draftsmanship that should be expected from the pupil that has reached this point in the "Preparatory Engineering Course", and about the field to be covered by Courses D5M and D6M and may be obtained by reference to Plates Nos. 1 to 8, inclusive, (pages [illegible]), the work of a student in the author's classes.

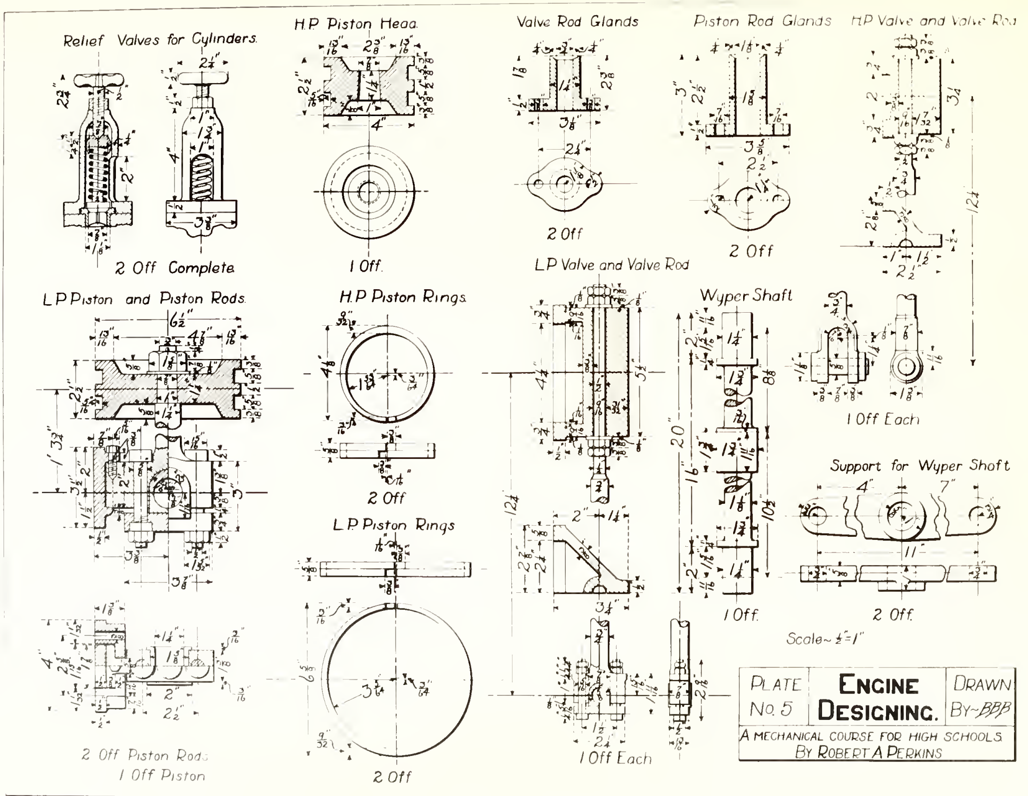
The Courses D5M and D6M are really one continuous course and provide for the design of one of two problems, either a vertical type steam engine or a gas engine of the same type. The plates required in the two courses are:




| | | |
|---|---|---|
| PLATE No. 4. | ENGINE DESIGNING | DRAWN BY~B.B.B. |
| A MECHANICAL COURSE FOR HIGH SCHOOLS. BY ROBERT A. PERKINS. | | |

Plates No.1 and No.4, inclusive, cylinder sections; Plates No.5 to No.8, inclusive, details of parts; and Plate No.9, front and side elevation of assembled engine. A tenth plate that may be drawn, in case time is found, is the isometric of the engine, but this course should never be crowded, as extreme neatness and accuracy are much more important in machine design than multiplicity of plates. As it is necessary for the student undertaking either of the above problems to have several plates under construction at the same time, it is the author's plan that no attempt should be made to complete any definite part of the design at the mid-year, but rather, that two credits be given at the end of the year when the nine plates are submitted.

Finally: At the completion of each of the


Relief Valves for Cylinders.
2 Off Complete
H.P. Piston Head.
1 Off.
Valve Rod Glands
2 Off
Piston Rod Glands
2 Off
HP Valve and Valve Rod
LP Piston and Piston Rods.
2 Off Piston Rods
1 Off Piston
H.P. Piston Rings.
2 Off
L.P. Piston Rings
2 Off
LP Valve and Valve Rod
1 Off Each
Wyper Shaft
1 Off.
1 Off Each
Support for Wyper Shaft
2 Off.
Scale~ ½"=1"
PLATE No. 5
ENGINE DESIGNING.
DRAWN BY~BBB
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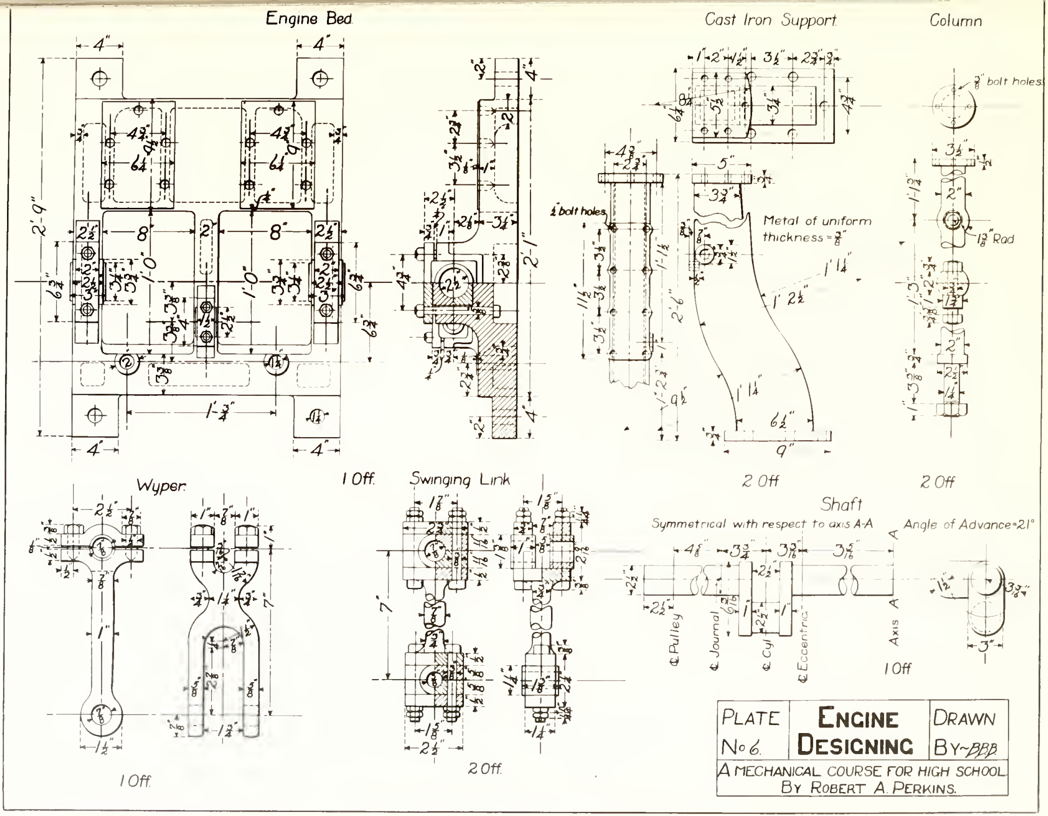
BY ROBERT A PERKINS

A Mechanical Course For High Schools.

courses in drawing every student, regardless of his grades, should be required to take a thorough examination, of not less than four hours duration, in the theory of the subject covered. In no other way can he be assured that none of the important details have escaped him.


Engine Bed
1 Off.
Cast Iron Support
Metal of uniform thickness = 3/8"
2 Off
Column
3/8" bolt holes
1 3/8" Rad
2 Off
1/2" bolt holes
Wyper
1 Off.
Swinging Link
2 Off.
Shaft
Symmetrical with respect to axis A-A
Angle of Advance = 21°
℄ Pulley
℄ Journal
℄ Cyl
℄ Eccentric
Axis
1 Off
PLATE No 6.
ENGINE DESIGNING
DRAWN BY ~ BBB
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BY ROBERT A. PERKINS.

A Mechanical Course for High Schools.

-Outline of-

SHOP COURSES.

As a prerequisite to the shop courses of the High school, the boy should have received two years of wood work in the grades, the minimum time allowance for which was fifty-four hours a year. During that time careful instruction should have been received in the care of tools, characteristics of woods commonly used in construction, joinery, and the use of hot glue. The courses, hereinafter outlined, should not be attempted without arranging for this preliminary work.

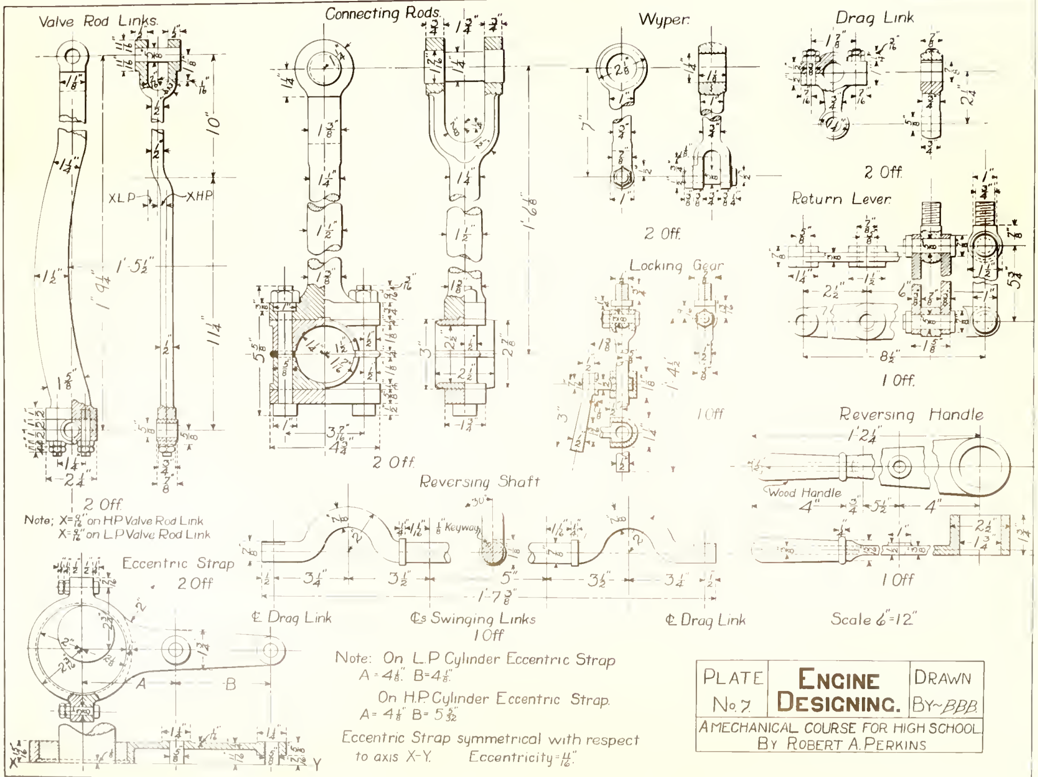
Course S1.

Beginning with the first year in High school, all the exercises are in practical construction and are of a progressive nature, making it possible for the student to see why i

A Mechanical Course for High Schools.

is necessary to do the problem in order that he may have sufficient skill successfully to attempt the next. With the drawings for this work he is already familiar, for he has made the drawings in the drafting class which precede the shop course. This statement applies to the shop courses without exception. Whenever alternative designs are offered, the pupil should be urged to decide upon the one he will wish to construct before starting upon his drawing, for only in this way will he receive the full benefit of the course outlined. Under no circumstances should shop work be permitted upon exercises for which complete drawings have not been made.

Three exercises, as explained in Course DI, constitute the required work for this semester. Whether hand or mill work be used upon any particular exercise should depend to a very



Valve Rod Links.
2 Off
Note; X=9/16" on HP Valve Rod Link
X=9/16" on LP Valve Rod Link
XLP
XHP
Connecting Rods.
2 Off
Wyper.
2 Off.
Drag Link
2 Off.
Return Lever.
1 Off.
Locking Gear
1 Off
Reversing Handle
Wood Handle
1 Off
Reversing Shaft
1/8" Keyway
℄ Drag Link
℄s Swinging Links
1 Off
℄ Drag Link
Scale 6"=12"
Eccentric Strap
2 Off
Note: On L.P. Cylinder Eccentric Strap
A=4 1/8" B=4 1/8"
On H.P. Cylinder Eccentric Strap.
A=4 1/8" B=5 5/32"
Eccentric Strap symmetrical with respect
to axis X-Y. Eccentricity=11/16"
PLATE No. 7
ENGINE DESIGNING.
DRAWN BY~BBB
A MECHANICAL COURSE FOR HIGH SCHOOL
BY ROBERT A. PERKINS

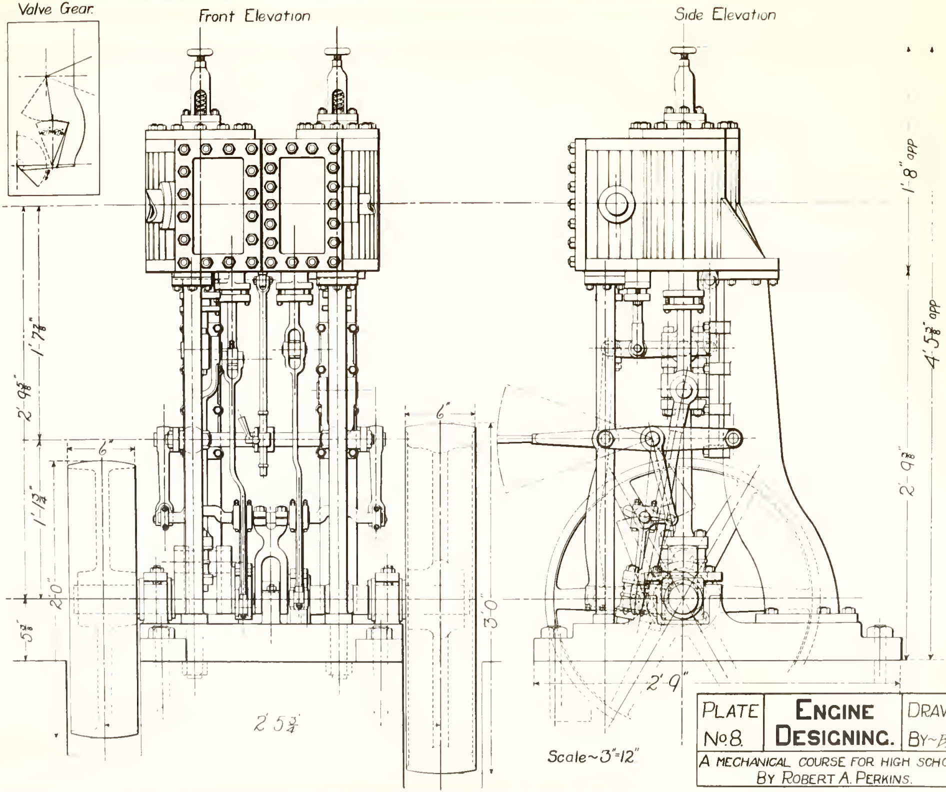
great extent upon the instructor's estimate of the individual pupil's strength and ability.

Course S2.

This is a continuation of Course S1., the exercises, however, being more difficult, the grade of workmanship insisted upon of higher quality, and especial attention being given to staining, filling, varnishing, etc. Two exercises only are required for credits, one from the designs of Course D1. and one the cabinet designed in D2., Plate No.3.

Course S3.

At this time a beginning is made in wood turning, the exercises consisting of six spindles, one piece for chuck turning, and one built-up pulley pattern. Alternative exercises are offered which may be used at the discretion of the supervisor. The author has found that it adds interest to this work to



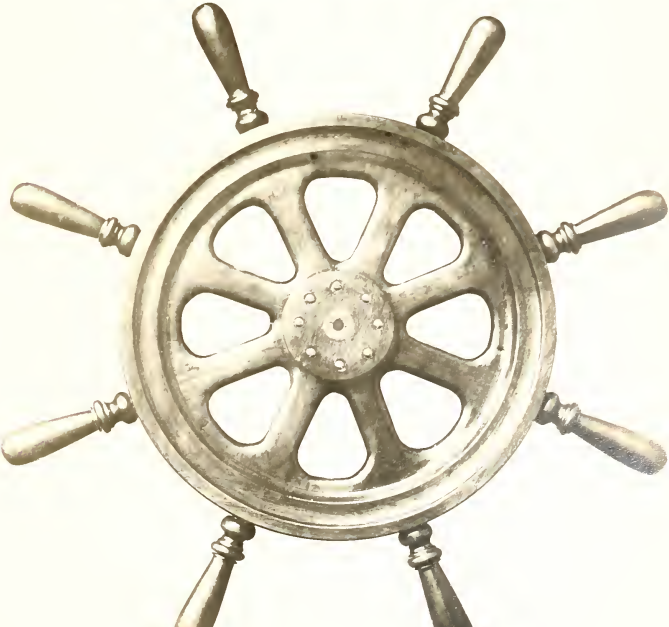

| | | |
|---|---|---|
| PLATE No. 8. | ENGINE DESIGNING. | DRAWN BY ~ BBB |

A MECHANICAL COURSE FOR HIGH SCHOOLS
BY ROBERT A. PERKINS.

allow the pupil to use a light and dark colored wood in building up the exercises. Some of the results obtained will be seen by reference to the cuts on pages .
The first two plates of D2 call for the designs here required. A high shellaced finish is expected on each exercise submitted for credit.

Course S4.

This is a continuation of Course S3 and provides for the making of patterns and core boxes for the gas engine and marine type steam engine for which the drawings are made in Courses D5M and D6M. Unlike the preceding shops, this and the succeeding courses call for the combined efforts of the class upon a unit product. An added value, educationally, is the result, for the individual can see how essential it is that his work be done with accuracy in order

that it fit in with that of others. The supervisor, however, will be called upon to give even more careful attention to this department for the assignment of each student being different, the remainder of the class must be kept informed as to what is being done, what difficulties are presented, and how they are to be overcome. While the text explains the construction of each pattern, it will be evident that only the instructor can see to it that each individual earns his credit, for no two patterns have, even approximately, the same difficulties.

Course S5.

At this point in the shop schedule forging is introduced. Logically, of course, the foundry should follow pattern making, but for two reasons the author has reversed this order. The first of these reasons is that in

A Mechanical Course For High Schools.

Any school system introducing these courses it will, in all probability, be found desirable to provide space and equipment for the machine shop than for the foundry; and therefore, the course may be carried one more year further without providing for the housing of a cupola, etc. The second reason is that far more strength and cool-headedness are required in handling molten iron than is required in any other shop, and it is thought well to postpone it until after the forge shop in which the boy is introduced to hot iron and the careful and rapid handling of it.

In this course the following subjects are treated; forging at the anvil and under the steam hammer, welding, tempering, and heavy forging. Course DE supply advanced material in these branches. Plates 1 and 2 of Course DE cover the design of the exercise for DE.

A Mechanical Course For High Schools.

Course S6.

In the foundry, commencing with bench work, or the molding and casting of the simple turned pieces of S3., the difficulty of the work is increased as the course progresses by the use of the patterns of S3.; and finally, by those of S4, is made to introduce the baked sand core, the flask with false cheeks, and the heavy floor work. Light work will also be done in brass and white metal.

Course S7.

The finishing of the castings and forgings made in S6 and S5, respectively, and in advanced shop S8, constitutes the work of this shop course.

A few simple exercises in chipping and filing are first required after which the student takes up, in succession, exercises which require him to use the lathe, drill press,

A Mechanical Course For High Schools.

shaper, planer, grinding machine, milling machine, and many other special tools. Course S8 in machine shop merely continues the work of S7 with the addition, however, of several exercises in tool making.

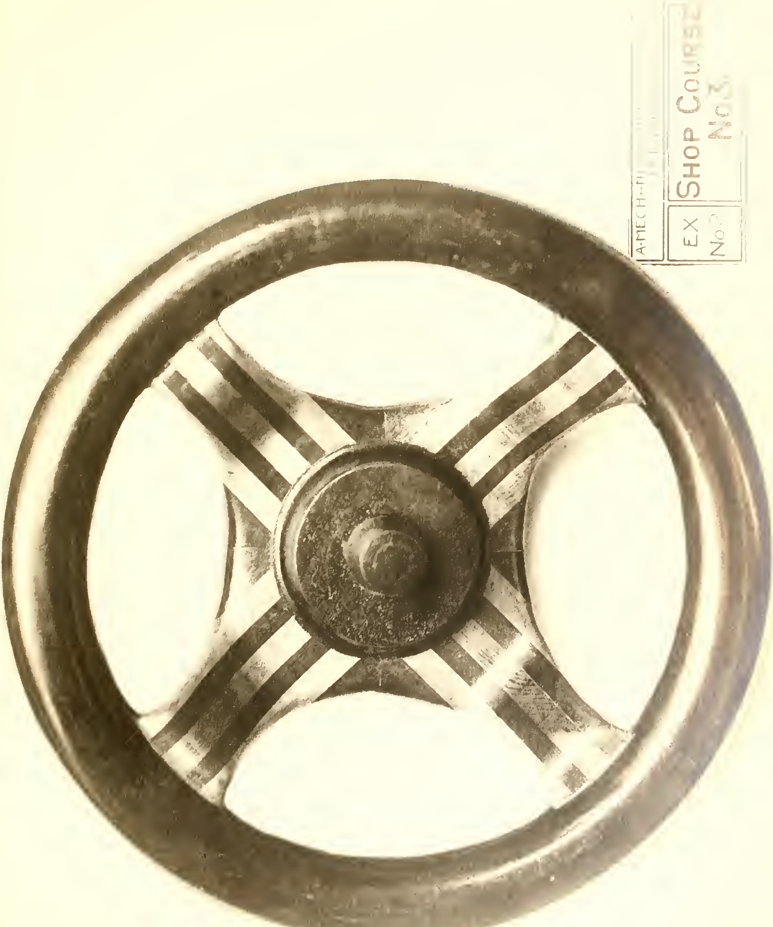
<u>Course S8.</u>

This is an advanced course in S4, S5, S6, or S7, and is open to only the students in the "General Trade Course".

<u>Courses S9 and DT1.</u>

These are offered only in the "General Trade Course" and are truly vocational in their scope. The courses offered are "Carpentry", "Automobile Construction", "Sheet Metal Working", "Steam Fitting", including "Heating and Ventilation", and "Electric Wiring".

In conclusion it may be said that all of the courses here presented call for a quantity


SHOP COURSE
No. 3

A Mechanical Course For High Schools.

of product and a quality of workmanship that will require the student of average ability to give his undivided attention to the work if he is to end the semester unconditioned.

In no other way than by requiring a strict discipline and a product of which the student and the school alike may be proud, can courses of the pre-vocational type be placed upon the same high plane that is occupied by the other departments of education.

Too often the "Last Chance" of those who are simply "going through" high school, the Manual Training Department has provided "busy-work" for which credit was given and which commanded the respect of no one, least of all the students themselves. It is the author's sincere hope that no such criticism can be made of the work as herein outlined

# A P P E N D I X.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Lechanics.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]. (Continued.)

[illegible] "[illegible]."
(Author) [illegible].
(Pub.) [illegible].

[illegible] "[illegible],
[illegible]."
(Author) [illegible].
(Pub.) [illegible].

[illegible] "[illegible] R [illegible]."
(Author) Victor [illegible].
(Pub.) [illegible].

[illegible] "The [illegible]."
(Author) [illegible].
(Pub.) [illegible].

[illegible] "[illegible]."
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School

John Wiley & Sons.

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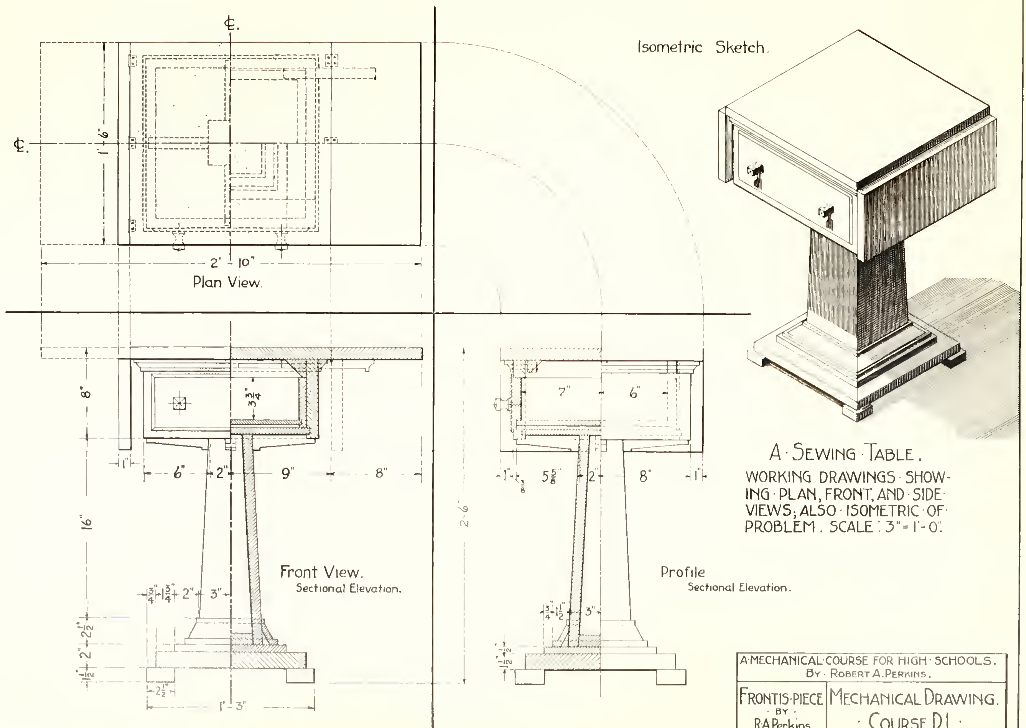



A · SEWING · TABLE.

WORKING DRAWINGS · SHOWING · PLAN, FRONT, AND · SIDE · VIEWS; ALSO · ISOMETRIC · OF · PROBLEM. SCALE : 3" = 1' - 0".

| A·MECHANICAL·COURSE FOR HIGH·SCHOOLS. BY · ROBERT A. PERKINS. | |
|---|---|
| FRONTIS-PIECE · BY · R.A.Perkins. | MECHANICAL DRAWING. · COURSE D1 · |

A Mechanical Course For High Schools.

MECHANICAL DRAWING.

Course D1.

DEFINITIONS:-

<u>Mechanical Drawing</u> is the graphical representation of objects, problems, or projects upon plane surfaces by the use of instruments. In this respect it differs from the pictorial form of representation, which depends upon the hand and eye alone and seeks not for extreme accuracy so much as for proportion and grace of outline and the imparting of texture to surface.

<u>Descriptive Geometry</u> is the science of drafting and, therefore, comprises all the theory of projective drawing of whatever form. The three forms of projection presented in the following text are:

Orthographic Projection, or
Perpendicular projection.

Perspective or Converging Projection

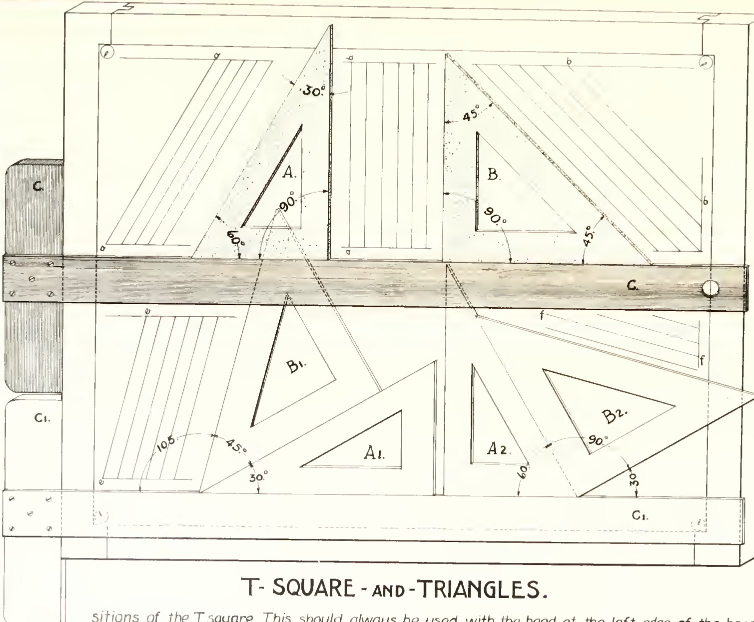
Single Plane Projection, or
Isometric Projection.

From the foregoing definitions, it will be evident that Descriptive Geometry and Mechanical Drawing bear the same relation to each other as do theory and practice. Either is of but little value without the other.

Drafting Instruments are mechanically constructed devices by means of which precise projections may be constructed.

A book might be written with Drafting Instruments as its subject, explaining the innumerable types that have been invented to fulfill the regular and special requirements of the drafting room. For this course, however, a brief space will suffice to give a list of the tools required, to present an ex-

| | | |
|---|---|---|
| A·MECHANICAL·COURSE·FOR·HIGH·SCHOOLS· | | |
| PLATE A | MECHANICAL DRAWING· | BY ROB'T A. PERKINS. |




## T- SQUARE - AND - TRIANGLES.

*Fig A* shows a triangle whose angles are 30 degrees, 60 degrees, and 90 degrees. Lines a-a indicate the parallels that are drawn at 60° and a-b those at 90°, to the horizontal edge of the T square C, by this triangle. Two other positions of this thirty or sixty degree triangle are shown at A1. and A2.

*Fig. B* shows what is known as the 45 degree triangle and lines b-b and a-b represent two of the sets of lines that may be drawn by its use.

*Fig. C* and *Fig. C1* show two positions of the T square. This should always be used with the head at the left edge of the board as indicated, the triangles and pen to be guided only by the upper edge of the blade.

Figs. A1-B1 and A2-B2 indicate how the triangles may be used in combination to produce other angles, such as e-e at 75° and f-f at 15° to the horizontal. Other angles, such as $22\frac{1}{2}°$, $37\frac{1}{2}°$ etc., may be obtained by bi-secting either the angles themselves or their combinations.

Practice Exercise:

From a point on a horizontal line, draw all the divergent lines possible with the 45° triangle and the 30° triangle indicating the number of degrees included between adjacent lines. Do the same exercise at another point using the triangles in combination, instead of singly.

A Mechanical Course For High Schools.

planation of them, and to show how they should be used and cared for.

A medium priced set of instruments is best suited to High school work; for, owing to carelessness and inexperience on the part of the students, loss of parts is certain to occur and accidents are frequent. The list required is as follows:

One 30 inch T-square; one 8 inch, sixty degree triangle; and one 8 inch, forty-five degree triangle, all shown in Plate A., with explanations accompanying; two small French curves and one 12 inch Architect's scale of triangular cross section, having 1/8 inch, 1/4 inch, 5/16 inch, 3/8 inch, 1/2 inch, 1 inch, 3/4 inch, 1 1/2 inch, 3 inch, 6 inch, and 12 inch scales per foot, shown and explained in Plate B.; and a set of drafting instru-

A·MECHANICAL·COURSE·FOR HIGH·SCHOOLS.

| PLATE B. | MECHANICAL DRAWING. | BY ROBT A PERKINS |
|---|---|---|

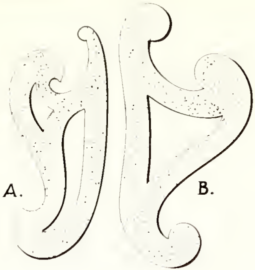



FIG. 1

FIG. 2

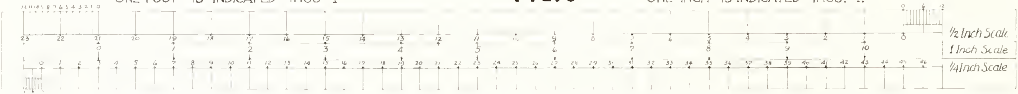
Two of the many forms of irregular or French curve are shown in Fig 1 A and B. Curves similar to these will be sufficient for the work of this course. No drafting instrument will be found that requires more care, patience, and practice to use with skill than does this.

In Fig. 2 points 1 to 24 inclusive are those determining an ellipse and these will be taken to illustrate the manner in which the curve is used in drawing. One portion of the ellipse will be drawn with B (from pt. 7 to pt. 13) and another with A (from pt. 19 to pt. 1) to show that the latter is more practicable in this particular example. To use the curves the following rules should be borne in mind:– 1ST Place so as to include as many points as possible. 2ND Draw line in pencil through these points. 3RD Find a part of French curve which will include two points through which line has already been drawn, and several additional points. 4TH Again draw in pencil starting with overlapping portion. 5TH Continue process 'till all the points are connected. 6TH In inking use but little ink in pen and draw only one-half of portions which overlap with each consecutive position of the French curve.

ONE FOOT IS INDICATED THUS 1

FIG. 3

ONE INCH IS INDICATED THUS. 1"




In Fig. 3 one face of the architect's scale is shown and, if the explanation here given is understood, the remaining two sets can be used without difficulty. Scales were designed in order that drawings of large projects might be accurately made in a small space with every part in the same proportion and relation to every other part that must exist in the completed structure. It will be evident then that the larger the scale chosen the more nearly actual size the drawing will be and the more detail will be shown. Referring now to the figure it will be seen. 1ST That to the left of zero in the 1" and in the 1/4" scales is one unit divided into twelve equal parts each of which represents one inch to that scale; 2ND That to the right of zero in the 1/2" scale is a 1/2" unit similarly divided; 3RD That one actual foot equals twelve feet to a scale of 1"=1'-0", twenty-four feet to a scale of 1/2"=1'-0", and forty-eight feet to a scale of 1/4"=1'-0"; and 4TH That readings must be taken with 0 for the initial or starting point in order that figures of scale may give the correct indication.

ments similar to that pictured in Plate 3.

Reference now to the last mentioned plate, will show that in figures one to six, inclusive, certain letters of reference are used to indicate those points to which particular attention should be given. These will now be explained in alphabetical order.

<u>"A"</u> Pencil attachment for compass.

The leg of the compass which receives the various attachments is provided with a joint just above "a", where the head of the screw is shown. This allows the attachments to be brought into such a position as will bring the pencil or pen point perpendicular to the paper when drawing any but very small circles. This adjustment is necessary, if good results are to be obtained. The arrow at "A" and the center line at the left indicate the direction and range of motion.

<u>"a"</u> In all the figures, this indicates a milled head and screw.

The turning of this milled head causes pressure to be exerted upon or removed from the various points of attachments, thus clamping them in the desired position or allowing of an easy adjustment.

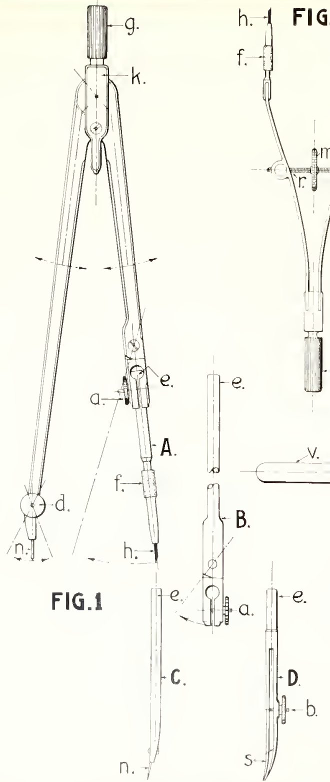



FIG.1

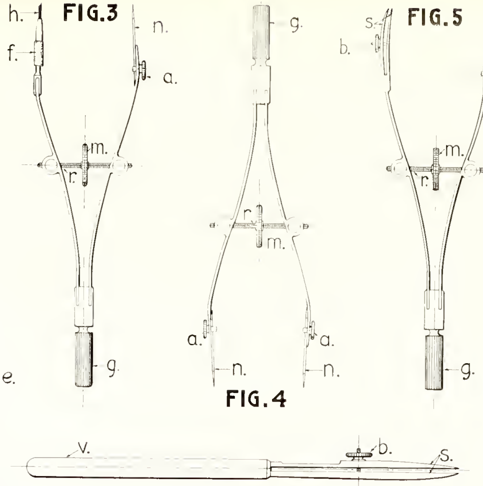



FIG.3

FIG.4

FIG.5

FIG.2

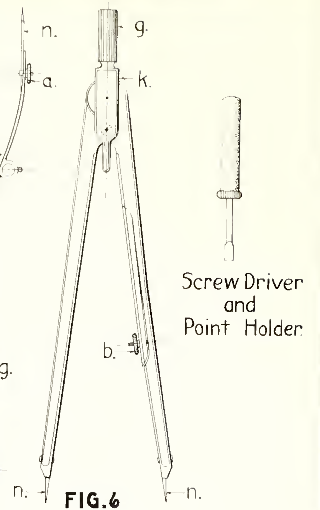



FIG.6

*Fig.1 shows large compass with A, pencil, B, extension bar, C, divider point, and D, pen, attachments; Fig.2 represents the drafting pen; Fig's 3, 4, and 5 give the three bow instruments viz: the pencil, divider, and pen; and Fig.6 shows large dividers.*

*The Richter type of instrument is here shown but the explanation, given on the adjoining page of the text, will be found to apply equally well to any other one of the many types in use.*

| A MECHANICAL COURSE·FOR HIGH · SCHOOLS. | | |
|---|---|---|
| PLATE C | MECHANICAL DRAWING. | BY ROB'T A. Perkins |

A Mechanical Course For High Schools.

"D" Extension-bar attachment for compass.

This bar practically doubles the length of the leg of the compass and thus makes possible the drawing of much larger circles. It will be seen that the bar is provided with a hinge joint, which answers the same purpose as the one described above.

"[illegible]" Milled heads of screws.

These are used for making delicate adjustments, such as regulating the width of line to be drawn, as in the case of the pens, or regulating the exact distance between the points of the dividers, as in the case of Fig. [illegible]

CAUTION:- Never exert a severe pressure upon any of these heads. The threads of the screws are very fine and may easily be stripped.

"G" Divider point attachment for compass.

When this is in place the instruments shown in Fig. 1 and Fig. [illegible] are used for the same purpose, viz. the accurate transferring of dimensions from one view or place to another, or the dividing of a given line into a required number of equal parts by trial.

"[illegible]" Pen attachment for compass.
See "[illegible]" for explanation.

A Detachable [illegible] C[illegible] [illegible].

"[illegible]" Lifted head and [illegible].

This allows the point "[illegible]" to be [illegible] into a position perpendicular to the paper, as indicated by the [illegible] position, and to be firmly clamped in place when adjusted.

"e" This represents the [illegible] of all the attachments which slip into the socket of the large compass. In Fig. 1, the [illegible] tion of the pencil attachment is shown in place.

"f" Knurled portion of pencil holder.

This facilitates [illegible] the cap which clamps the pencil lead in place.

"g" Knurled head of all compasses.

The compass should always be handled by [illegible] [illegible] the adjustment.

"h" Pencil point.

These should be sharpened to a [illegible] and be placed, as indicated, with the sharp edge in.

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"h" At this position, in the better grades of instruments, will be found a device which keeps the lead "g" in a perpendicular position, relative to the plane of the circle being drawn.

"m" Milled head of screw.

These heads are attached to right and left-hand screws which regulate the distance between the points.

CAUTION:- Never leave the bows for long together when not in use set any way, for the spring will soon leave them in [illegible]. Remember also that when the threads "r" are broken, the compass is ruined; therefore, they should be kept free from rust and should never be forced by an extreme tension of the milled head on the screw.

"n" Points of compasses and dividers.

These points may be readily replaced in this type of instrument when they become dull or bent and this fact, in the author's opinion, is a great advantage to be considered when deciding upon the set that will be purchased. Many compasses are constructed with permanent points and when these become bent or broken, the otherwise valuable instrument is made worthless.

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"r" Combined right and left-hand screws.

In some designs, a right-hand thread alone is used, but in that case, the milled head is placed outside the bow end, instead of turning the screw, turns upon it and forces the bows together.

"s" Points of pens.

These should always be kept clean and sharp, for it is useless to attempt to do satisfactory drafting under any other conditions.

In using the ruling pen, shown in Fig 2,

First:- Fill, not too full, by placing quill from ink bottle between points "a,"

Second:- Hold pen in such a way that "b" will point out and be readily accessible to the thumb and first finger, without shifting the pen in the hand.

Third:- Outside the margin of the plate, on the portion that is to be removed, draw several short lines, changing the adjustment of "b" each time until the desired weight of line is found.

Fourth:- Ink in the horizontal lines, keeping pen inclined so that the line being drawn is about 1/8 inch from the T-square. Let the pen rest lightly against the square, as if pressing against it it will close the points and either stop the flow of the ink altogether, or narrow the line so that it will be necessary to re-draw it.

CAUTION:- Remember that blots are caused by filling the pen too full, by attempting to draw too near the square, or triangle, by allowing the pen to turn so that the open portion comes in contact with the guide, by dropping the pen, or by holding pen near when attempting to blow some particle from the paper.

Fifth:- Ink the vertical and inclined lines, taking all precautions noted above.

NOTE:- When circles or portions of circles are tangent to straight lines, always draw the circle first, as a very slight adjustment may be made in the case of the lines, but the circle is a fixed quantity.

Sixth:- Clean pen thoroughly every few minutes.

"V" Pen Handle:-

Never buy a pen with a bone handle. Even those of wood are undesirable, as they are easily loosened and broken. A metal handle is altogether the most satisfactory.

In general, it may be said that one can judge by the care he gives his instruments, the kind of a draftsman any person will become.

If they are kept polished, in adjustment, and in a neat case; if the head of the T-square is not loosened, or the blade nicked, because of carelessness; if the curves and triangles are not warped from the manner in which they have been put away; and if the scale is kept clean so that divisions may be determined accurately, then the chances are all in favor of good results. On the other hand, indifference and rough treatment of the delicately constructed tools will be certain to yield inaccurate and worthless drawings.

Pencils:- Use a 4H "Koh-I-Noor" or equal, for all the drafting courses. Keep sharpened, with point long enough so that no wood will rest upon guiding edge of T-square or triangle.

Erasers:- Use a Ruby No.112 Faber for ink or heavy pencil lines and Art Gum for finally cleaning the plate. Never use the so-called ink erasers, glass erasers, or a knife, as all of these destroy the surface of the paper.

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Thumb tacks:- Use a small thumb tack, as the large sizes are difficult to remove and are apt to get in the way of the T-square, when one is working near the lower margin of the plate.

Ink:- Higgins black and carmine waterproof inks, or their equal, are to be used. When not in the act of filling the pen, keep ink bottles tightly corked, as the ink evaporates rapidly and becomes too thick to flow freely from the pen. Accidents will be avoided by following this recommendation.

Paper:- [illegible] sheets of fine-surfaced white paper are to be used throughout this course, unless otherwise specified, the brand to be "[illegible]" or equal.

Lettering Pens:- In the author's own work, as well as in that of his classes, he has found the [illegible] 506 [illegible]-pointed pens give the best results. This is a matter that, to a large extent, must be determined by each person.

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RULES TO BE OBSERVED
in the
DRAFTING ROOM.

I-

Always wash your hands before each drafting period, "whether they need it or not."

II-

Be sure that your T-square, triangles, and drawing board are clean.

III-

Draw lightly. A heavy pencil line grooves the surface of the paper and makes erasures impossible.

IV-

Never be satisfied with a line that is partially erased. If it is necessary to erase it at all, remove it entirely.

V-

Never use the so-called ink erasers, glass erasers, or a knife to remove a line, as all of these destroy the surface of the paper.

VI-

Never hand in a plate that you have not, to the best of your ability, made as clean as when it left the mill.

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VII-

Do not try to hurry at first. Speed will come with practice, but with the inexperienced will mean carelessness.

VIII-

Never let a step go by that you do not understand. If he sees that you are determined to understand the subject, the instructor will respect your persistent questioning.

IX-

Learn to discriminate between "receiving help" and "cribbing." The former is allowable upon occasions and may be of benefit both the giver and the receiver of the information. The latter is stealing and destroys the character and ability of the one who practices it.

X-

Do not borrow. Learn to anticipate your needs so that you will have the tools required when the time comes to use them. To borrow frequently indicates a lack of character, a lack of self-respect.

The qualifications of an efficient draftsman may be summarized approximately as follows:

First: Style in lettering, [illegible]

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pid execution; third, previous experience; fourth, ingenuity and inventiveness; and fifth, mathematical accuracy. Each of these is of the utmost importance and if lacking any one of them, the "would-be" draftsman is sadly handicapped. Previous experience is likely to imply both neat and rapid execution, especially in lettering and is of value only as it makes these possible. This experience may be most readily obtained by concentrated effort in schools; but place may be found, though much more slowly, in outside offices. Mathematical accuracy and inventiveness, however, are more likely to be inborn qualities and, though they may be developed, are seldom, if ever, acquired.

As the proportion of style in lettering is the most difficult task that confronts the

THE FOLLOWING ALPHABETS, EITHER VERTICAL OR AT 75 DEGREES, ARE USED IN COMMERCIAL PRACTICE.

1234567890 $\frac{1}{2}\frac{1}{4}\frac{1}{8}$

ABCDEFGHIJKLMNOPQRS
TUVWXYZ.

abcdefghijklmnopqrstuvwxyz.

*1234567890 $\frac{1}{2}\frac{1}{4}\frac{1}{8}$.*

*ABCDEFGHIJKLMNOPQ
RSTUVWXYZ.*

*abcdefghijklmnopqrstuvwxyz.*

**ABCDEFG
HIJKLMNOPQ
·RSTUVWXYZ·
1234567890**

THE · ARCHITECTURAL · STYLE

ABCDEFGHIJKLMNOPQRSTUVWXYZ

&

1234567890¼¾.

abcdefghijklmnopqrstuvwxyz.

I · AM · ONLY · A · PIECE · OF · WORK.
AFTER · I · LEAVE · YOUR · HANDS
YOU · MAY · NEVER · SEE · ME · AGAIN.
PEOPLE · LOOKING · AT · ME, HOW-
EVER, WILL · SEE · YOU · AND, SO · FAR
AS · THEY · ARE · CONCERNED,
I'LL · BE · YOU.
IF · I · AM · SHABBY · AND · POOR-
LY · MADE · I · WILL · GET · INTO · BAD
COMPANY.
IF · I · AM · WELL · MADE · I · WILL
GET · INTO · GOOD · COMPANY · AND
HELP · TO · KEEP · UP · THE · STANDARD.
PUT · INTO · ME · YOUR · BEST
SO · THAT · I · MAY · GO · THE · WAY
OF · ALL · GOOD · WORK · AND · SAY
TO · ALL · THE · WORLD · THAT,
"I · STAND · FOR · A · WORKMAN · WHO
NEEDETH · NOT · TO · BE · ASHAMED."

WILLIAM CHANDLER SMITH.

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|---|---|---|
| PLATE D. | MECHANICAL DRAWING | BY ROB'T A. PERKINS |

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beginning student the author has thought best to introduce the course with two plates in this branch of the art.

Plate No.1.

Plate "D" shows, at the left, a few of the many types of letters which have been designed for various purposes. These, however, are the styles most used in engineering and architecture, and Plate No.1 will consist of the duplication of this part of Plate "D" in the following manner:-

INSTRUCTIONS:-

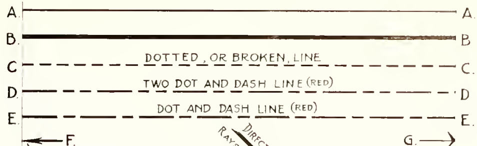
<u>1st.</u> Lay out border lines of plate as indicated in Plate "D".

<u>2nd.</u> Divide plate into two equal parts by a vertical line, as in plate "D".

<u>3rd.</u> Rule plate for required letters. Make the heights of letters as follows:

Capital letters ..........5/16"
Vertical Capitals and Figs....3/16"
Vertical Lower Case........[illegible]" and 1/[illegible]"

## Types of Lines to be Used.



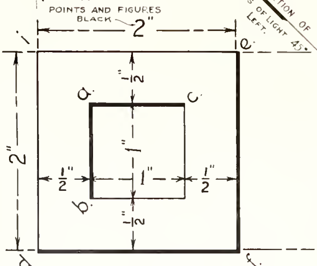




Fig. 1

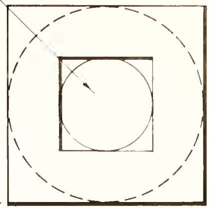


Fig 3

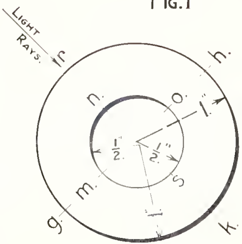



Fig. 2

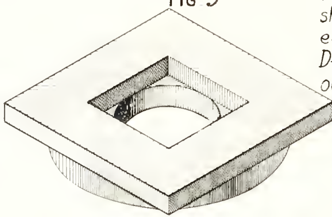


Fig. 4

## Explanation.

*Although some freedom is exercised as to the weight and style of line selected for the various phases of the work, still, by following the instructions here given, the pupil will readily understand whatever system he is called upon to use.*

*Fig. 1. Square block with square hole therein.*

*Fig. 2. Round block with concentric round hole.*

*Fig. 3. Plan, or top, view of Fig. 1 placed above Fig. 2*

*Fig. 4. Isometric drawing showing same condition as exists in Fig. 3. These illustrate the use of lines A-A to E-E and it will be noted:—*

*1st That the rays of light, which illuminate all the views of an object, come at 45° L across the plate; 2nd That A-A lines are used toward the light, where two light surfaces intersect, and that B-B lines are used away from the light, where a light surface intersects one in shade; 3rd That C-C lines indicate the position of edges concealed by intervening surfaces; 4th That D-D lines connect different views of the same object; and that E-E lines, with arrows F, (never G) are used to show dimensions.*

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|---|---|---|
| Plate E. | Mechanical Drawing. | By Rob't A Perkins |

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75 degree High Caps....[illegible]/16"
75 degree Lower Case....[illegible]/16" and 1/[illegible]"
Block Letters..........5/8"
Small Arch't Capitals ....[illegible]/8"
Arch't Capital [illegible]......[illegible]/16"
Arch't Lower Case.......7/1[illegible]" and 1/8"

The space between the lines of lettering is to be made 1/5 of height of capitals of that group or equal to that of the small lower case letters, such as "a","c", etc.

The distance between the groups is to be determined by eye to give the same appearance as that of Plate "[illegible]".

4th In the left half of plate, carefully pencil the letters and, when they have been approved by the instructor, ink them in. Make them, so far as possible, by a series of single strokes and retrace the lines as seldom as possible. A steady hand and a clear mental image of the letter, and the combination of strokes of which it is composed, are the objects the pupil must always have in mind.

5th. In the right half of the plate, reproduce the exercise, this time pencilling only the first letter of each line, for the sake of location. The block letters will, of course, be constructed with the instruments in both cases.

5th. If the first effort is unsatisfactory, repeat several times if necessary.

Plate No.2.

For the second plate, the author has chosen a few lines from the writings of William Chandler Smith, which appeal to him as particularly appropriate for a course of this nature. Surely, with this as an ideal, there would be few failures in any field of endeavor.

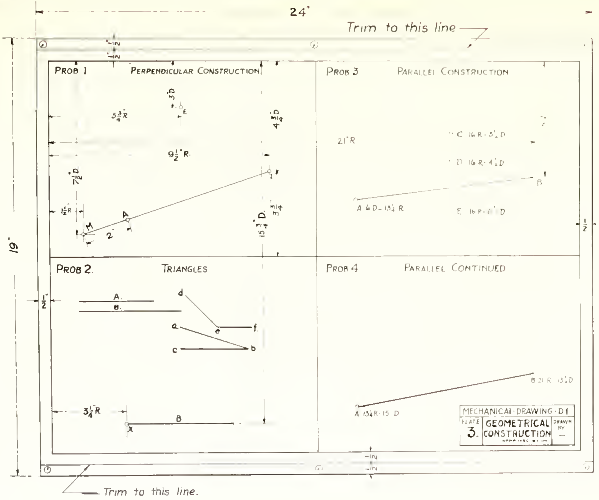
INSTRUCTIONS:-

1st. Draw margins and divide plate as in Plate No.1.

2nd. Rule plate, making small capitals 3/16" and large capitals 7/32". The space between lines of lettering to be 3/16".

3rd. Pencil in the left half of plate in either the vertical or 75 degree alphabet of capital letters and ink with single strokes, as in previous plate.

4th. Repeat the lettering in the right half of plate, this time pencilling only the first word in each line, in order that the




## PLATES NOS. 1, 2, AND 3.

PLATES NOS. 1 AND 2. These plates are in lettering and the specifications for them will be found on the preceding page of the text.

PLATE NO. 3. The accompanying figure indicates the manner in which the plate is to be planned to receive the first four problems of course D1.

PROB 1 Given:—Line MI [M. $7\frac{1}{2}$"D-$1\frac{1}{2}$"R and I $4\frac{3}{4}$"D-$9\frac{1}{2}$"R], point A. on MI. 2" from the lower end, and E. 3"D-$5\frac{3}{4}$"R.

Required:—The construction of the perpendicular bisector of MI and of perpendiculars to MI from points A, E, and I

PROB. 2 Given:—Any two lines A and B, angle abc, and angle def. X $15\frac{3}{4}$"D-$3\frac{1}{4}$"R

Req:—The construction of three triangles with sides A and B; one with acute angle abc, one with obtuse angle def, and one with a right angle included.

PROB. 3. Given:—Line AB and points C, D, and E. [A. 6"D-$13\frac{1}{4}$"R, B. 5"D-21"R], C. $3\frac{1}{2}$"D-16"R, D. $4\frac{1}{2}$"D-16"R, and E $6\frac{1}{2}$"D-16"R.

Req:— A parallel to the line AB through C, D, and E constructed by a different method in each case.

PROB. 4. Given:—Line AB. [A. 15"D-$13\frac{1}{4}$"R and B. $13\frac{1}{2}$"D-21"R]

Req:— The division of AB into seven equal parts by means of parallels. Check results.

NOTE: For detailed instructions, for solving the poblems of this and all succeeding plates, see the text accompanying them.

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| PLATE F | MECHANICAL DRAWING·D1· | BY ROBT A. PERKINS |
|---|---|---|

indentation may be correct.

5th. If the first effort is unsatisfactory, repeat several times, if necessary.

6th. Design a [illegible] which may be used, with slight variation, throughout the entire [illegible] place in the position indicated in plate "[illegible]".

Plate No.[illegible].

Referring now to plate "[illegible]", [illegible] the margin lines and divide the sheet as indicated for plate No.[illegible].

INSTRUCTIONS:- Problem No.1.

1st. Draw the line [illegible] and locate the points A and B. Do not show construction lines in this or succeeding problems of Plate [illegible].

2nd. Read the problems until they are thoroughly in mind.

3rd. Solve the problem as follows: With [illegible] as a center and any radius greater than one-half [illegible], draw arcs above and below the line. With [illegible] as a center and with the same radius, draw other arcs intersecting those just drawn at point [illegible] above the line and point [illegible] below the line. Connect points [illegible]. This is the perpendicular bisector of [illegible].

4th. With A as a center and with any convenient radius, draw arcs cutting the line [illegible] in a point to the right of A, which we will call

ber 3 and one to the left of A which we will number 4. With 3 as a center and any convenient radius greater than 3-A, draw arcs above and below the line I. With 4 as a center and the same radius, draw arcs intersecting those first drawn in points 5 and 6. Connect 5 and 6. If the work has been accurately done, this line will pass through A and be the required perpendicular at that point.

5th. With E as a center and radius somewhat greater than the distance from E to XI, draw an arc cutting XI in points 7 and 8. With 7 as a center and a radius greater than one-half 7-8, draw an arc below the line. With 8 as a center and the same radius, draw an arc cutting that arc, with 7 as a center. Number the point of intersection 9, and draw E-9, which will be the required perpendicular from E to XI.

6th. Assume any point 10 a short distance above the line and to the left of I. With 10-I as a radius, draw a circle cutting the line XI in the point 11. Draw 10-11 and extend to cut the circumference of the circle in point 12. Line 12-I is the required perpendicular to the line XI at I.

NOTE:- In inking problems, referring to Plate I, all construction work will be shown in dotted red lines, as indicated at C, and all given and required lines in black of the weight shown at A. This applies to all plates of this course.

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QUESTIONS:-

I-

What suggestions can you make as to practical applications of the preceding problems in perpendicular construction?

II-

What instruments are used by builders and engineers for the construction of exact perpendiculars?

INSTRUCTIONS:- Problem 2.

1st. Draw the line D.

2nd. Read the [illegible] until they are thoroughly in mind.

3rd. Letter the [illegible] of the line A, B, and C.

4th. With B as a center, draw an arc cutting the lines ab and cb at the points 1 and 2, respectively.

5th. With the same radius and with 2 as a center, draw an arc, cutting the line D at point 3 and extend the arc indefinitely.

6th. With dividers, transfer the distance 1-2 to the arc, just drawn from 3, making the distance 3-4 on this arc equal to 1-2.

7th. Through 4, [illegible] line 1-y [illegible] it equal to A.

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8th. Let [illegible] x,z [illegible]. Triangle xyz is the required construction, employing the acute angle.

9th. In the same way let [illegible] transfer def, placing [illegible] completing the obtuse triangle.

10th. To construct the right triangle, make use of that part of Problem I, by means of which the perpendicular is constructed at I. In this [illegible], construct a [illegible] at K, making its length equal to [illegible]. Connect the upper end of [illegible] with J. The triangle, [illegible], will be the required right triangle.

QUESTIONS:-

I-

Where are triangular forms [illegible] in building and engineering [illegible]?

II-

What can be said of the rigidity of the triangle [illegible]?

III-

Does the [illegible] rigidity [illegible] the examples you have given in answer to the first question?

INSTRUCTIONS:- PROBLEM V.

1st. Draw the line [illegible]

points C, D, and E.

2nd. Read the requirements carefully.

3rd. Draw any line through the point C, extending it to intersect A-B at point 1.

4th. Transfer the angle C1B (as in preceding problem), letting point 1 fall at point C, the point C at the point [illegible], and let the line 1-B extend to the left of C.

5th. For the appearance of the figure, make this line, which is the required parallel through C, equal to and directly above A-B.

6th. To construct the line parallel to A-B through point D, erect a perpendicular to A-B at D and at A. Lay off the distance from D to the line A-B, as measured on the perpendicular at that point, from point A on the perpendicular at A, numbering the point, thus determined, 2. The line connecting 2 with D is the required parallel. For the appearance of the figure, make this line also equal to A-B.

7th. To construct the parallel through E, place either triangle with one edge exactly coinciding with A-B and, holding it in this position, place one edge of the other triangle in contact with that edge of the first triangle, which happens to be most nearly in a vertical position. Now holding the last mentioned triangle firmly in position, slide the first along it until the edge that was along A-B reaches the point E. The line drawn along this edge, through

E, will be the required parallel through this point.

QUESTIONS:-

I-

Where are parallels found in construction work? Mention several important instances.

II-

How do builders and engineers check their accuracy?

III-

Would figures composed of two pairs of parallels have rigidity?

IV-

Mention a few mechanical devices you have seen that prove the correctness of your last answer?

INSTRUCTIONS:- Problem 4.

1st. Draw the line A.B.

2nd. Read the requirements carefully.

3rd. Draw a line of indefinite length extending from A in the general direction of B and at any convenient angle to A.B.

4th. On this line, beginning at A, lay out any convenient length seven times, numbering the points from 1 to 7

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<u>5th.</u> Draw the line 7-B and parallel to this through the remaining six points, draw lines intersecting A-B. These points of intersection will divide the line A-B into the required seven equal parts.

<u>6th.</u> For the check required, draw another line from A, laying off upon it seven equal lengths, slightly different from those in the first part of the problem. Construct the parallels through the points on this line by one of the methods of problem 3 not used in the first part of Prob. 4 The parallels, thus constructed, should pass exactly through the points on A-B determined by the first method.

QUESTION:

I-

What advantage has this method of dividing a line into any required number of equal parts over that of trial or of measuring its length and, after computing the length of the required parts, laying these out upon the line?

Plate No.4.

INSTRUCTIONS: Problem 5.

<u>1st.</u> Draw margins and divide plate as indicated in Plate C., Fig.1.

<u>2nd.</u> Locate the points (a) and (b) and draw the line ab.

# Plates No.4 and No.5 D.1

**Plate No.4** *See Fig.1 for arrangement of problems.*

*Prob.5 Given:– Two lines, a-b and b-c, with the length ratio of 3:4. Point a[3"R-8$\frac{3}{4}$"D] and b[5$\frac{3}{4}$"R-9$\frac{1}{2}$"]*

*Req:– A right triangle a-b-c; a square constructed on a-b divided into 9 equal small squares; a square constructed on b-c divided into 16 equal squares; and a square upon c-a divided into 25 equal small squares.*

*Prob.6 Given:– Two circles of 5" diam. with centers located at 20"R-4$\frac{5}{8}$"D and 14$\frac{1}{2}$"R-4$\frac{5}{8}$"D, the horizontal and vertical diameters of the left circle being drawn.*

*Req:– The subdivision of the angles A, B, C, and D into 2, 3, 6, and 8 equal angles respectively. By the use of the various angles, thus determined, it is also required that an inscribed equilateral triangle, square, hexagon, and octagon be constructed in the second given circle.*

*Prob.7 Given:– Line a-b 1$\frac{3}{4}$" long. a 16$\frac{1}{4}$"R-15"D, b 18"R-15"D.*

*Req:– The construction of a pentagon, hexagon, heptagon, octagon, and decagon upon a-b as one side.*

**Plate No.5** *This plate is to be divided in the same manner as Plate 3 and is to receive Problems 8, 9, 10, and 11. Fig.2 shows what is given in Prob.9 with letters and figures of reference. For problems, instructions, and questions see text.*

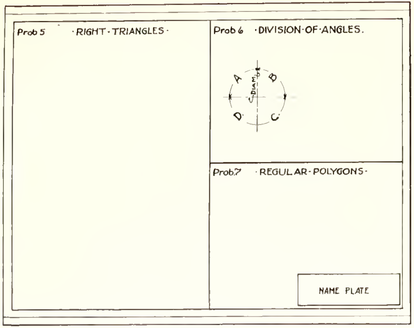


Fig. 1

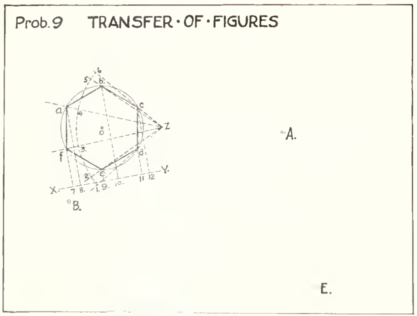


Fig. 2

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| PLATE G. | GEOMETRICAL CONSTRUCTION | By Robert A. Perkins |
|---|---|---|

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3rd. Determine the length of b-c and construct the right triangle a-b-c, making b-c perpendicular to a-b. (See problem 7, plate 3)

4th. Construct squares upon each side and sub-divide each of them as indicated in the requirements. (In constructing and dividing squares, use methods of problem 1, Plate 3 and problem 4, Plate 3.)

QUESTIONS:

I-

What name is given to the longest side of a right triangle?

II-

What relationship exists between the small squares of the figure just constructed, first as to size and then as to number on each of the three sides?

III-

Does this relationship exist for all right triangles?

IV-

How may the simple ratios of 3:4:5 be used to check the accuracy of foundation corners or other squares?

(Suggestion: Construct a right triangle as in the above triangle, making two sides at right angles with the ratio of 3:4. What will be the length of the third side in terms of the same unit to which the first [illegible] sides are drawn?)

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INSTRUCTIONS:- Problem 1--Part I.

1st. Draw [illegible] of the problem and read carefully its requirements.

2nd. To bisect angle A, first number the center of the circle 3, the left end of the horizontal diameter 1 and the upper end of the vertical diameter 2. With 1 as a center and a radius greater than one-half of 1-2, draw an arc and with 2 as a center and the same radius, draw a second arc, intersecting it at 4. Draw 3-4. This is the required bisector of angle A.

3rd. To trisect angle B, number the right end of the horizontal diameter 5 and with 5 as a center and radius 5-3, draw an arc cutting the circumference at 6. With 2 as a center and the same radius, draw a second arc, cutting the circumference and number this point 7. The radii drawn from points 6 and 7 to 3 are the required trisectors of the angle B.

4th. To divide angle C into 6 equal parts, first divide it into three equal parts, as in step (3), and sub-divide each part into two equal parts, as in step (2).

5th. To divide angle D into 8 equal parts, apply the method of step (2) three times.

QUESTIONS:- I-

Can an acute or obtuse angle be trisected by the method explained above? Why not?

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II-

How may such angles be trisected?

INSTRUCTIONS:- Problem 6--Part II.

1st. Draw the horizontal and vertical diameters of the second circle, numbering the upper end of the vertical diameter C.

2nd. Lay off from C, upon the circumference of this circle, a distance equal to that cut from the circumference of the first circle by any two consecutive trisectors of the angle A. Number this point 1. From 1, lay off another of these distances, and number the point obtained, 2. Continue this process of laying off the distances and numbering the points obtained. If accurately done, point 12 will fall at C.

3rd. Draw the lines C-4, 4-8, and 8-C. These form the required equilateral triangle.

4th. Draw the lines C-2, 2-4, 4-6, 6-8, 8-10, and 10-C. These form the required hexagon.

5th. Again starting at C, lay off upon the circumference of the circle, a distance equal to that obtained by bisecting the angle A in part one. Letter this point (a). Continue, as in the preceding part of this problem, to lay off this distance, only note that in this case, the points are to be lettered. If the work is accurately done, point (h) will fall at (a).

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6th. Draw the lines [illegible]-[illegible], [illegible]-[illegible], [illegible]-[illegible], and [illegible]-[illegible]. These form the required square.

7th. Draw o-a, a-b, b-c, c-d, d-e, e-f, f-g, and g-o. These lines form the required octagon.

QUESTIONS:- I-

What other regular polygons might have been constructed, in the second part of this problem, by the use of the angles obtained in the first?

II-

Which of the polygons constructed above has its sides all equal to the radius of the circumscribing circle?

III-

What is the simplest way to construct a hexagon?

INSTRUCTION:- Problem 7.

1st. Draw the line a-b.

2nd. Read the requirements carefully.

3rd. With (a) as a center and with (a-b) as a radius, draw an arc above ([illegible]).

4th. With (b) as a center and with the same radius, draw a second arc, intersecting that just drawn in point (c).

5th. Bisect the angle (a-c-b) and extend to meet (a-b) in one direction and indefinitely in the opposite direction.

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6th. Divide [illegible] (a-[illegible]) into 6 equal parts. [illegible] With [illegible] (c) as a center, revolve each of the points of division into the bisector of angle ([illegible]-c-[illegible]) which extends above C. Number the point [illegible] 6,1, and the other points in order [illegible].

7th. With (c) as a center and radius (c-1), revolve [illegible] 1 into the bisector of angle (a-b-c) locating point (c). Number this point 7.

8th. With point (7) as a center and (7-a) as a radius, draw a circle, and starting at point (a), lay off, upon the circumference, the distance (a-b) as many times as possible. If the construction is done with accuracy, (a-b) will be [illegible] in the circumference of the circle [illegible] ([illegible]) as a radius, [illegible] in succession, will form the [illegible] polygon.

9th. [illegible] point [illegible] as a center and the distance ([illegible]) as a radius, draw another circle and, as in the previous case, start at point (a) to lay off upon its circumference the distance (a-b). In this case, (a-b) will be found to be contained in this circumference seven times [illegible] the figure resulting from connecting the points in succession [illegible] heptagon.

10th. Apply the method given in the 8th and 9th steps to the construction of the [illegible] polygons [illegible] four as the [illegible] of the [illegible]

ing circles, the radii being ([illegible]) and ([illegible]), respectively.

NOTE:- This method is not mathematically accurate, except for the hexagon, and is, therefore, known as an "Approximate Method".

QUESTIONS:-

I-

What regular polygon would result when the above construction is applied to points [illegible], and [illegible] as centers?

II-

Mention a few instances where a knowledge of the construction of polygons might be of practical value, first, in construction work? Second, in industrial arts?

III-

Does a pentagon constructed by the following method agree with that constructed in the 8th step of Prob. 7?

1st. Draw the horizontal and vertical diameters of the circle, which is to be that circumscribing the required pentagon.

2nd. Erect the perpendicular bisector of either horizontal radius.

3rd. Letting the point of bisection be [illegible] and with this as a center, and a radius equal to the distance from [illegible] to either end of the ver-

tical diameter, [illegible] intersecting the horizontal radius, not bisected, in the point Y.

4th. Now the length of each side of the required polygon will be exactly equal to the distance from Y to either end of the vertical diameter, and it remains only to lay this off the required number of times upon the circumference to have determined the vertices of the pentagon.

Plate No. [illegible].

GENERAL INSTRUCTIONS:

1st. Divide plate as was done in the case of Plate 2, [illegible] in all other plates.

Problem 6.

GIVEN :-

A horizontal line (c-d) and a vertical line (a-b), bisecting each other at C (5 3/4"R-6 1/8"D). The length of (a-b) is 4" and that of (c-d) is 7". Draw the lines (a-d), (d-b), (b-c) and (c-a), thus forming a rhombus.

REQUIRED:-

The construction of an ellipse by the "Method of Revolution" and by the "Approximate Method", with (a-b) and (c-d) as minor and major axes. Also the construction of an approximate ellipse, inscribed by the rhombus (a-c-b-d)

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INSTRUCTION:- Problem 6--Part 1.

1st. Draw what is given of the problem.

2nd. With (C) as a center and radius (a-C), draw a circle.

3rd. With (C) as a center and radius (C-c), draw a circle.

4th. Extend a-b to intersect the circumference of the circle last drawn and bisect each quadrant, extending the dividing lines to intersect each circumference.

5th. At the point where each of these lines intersects the smaller circle, draw a horizontal line and drop a perpendicular to meet it from the point at which the same line intersects the larger circle. The points a, d,b, and c, together with the points obtained by the intersection of the horizontal and vertical lines just drawn, determine an ellipse by the "Method of Revolution".

6th. Draw this ellipse as accurately as possible free hand, in pencil, and finally, by means of the French curves, explained in Plate 1., ink in with great care. Follow the rules given in Plate 1. Ink construction in one quadrant only.

NOTE:- Why this is an ellipse of revolution will be explained in Course D3.

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INSTRUCTION:- Problem [illegible]--Part II.

1st. With ([illegible]) as a center and radius (a-c) draw an arc intersecting ([illegible]-[illegible]) at (e).

2nd. Construct the perpendicular bisector of e-d, lettering the point at which this crosses the major axis (f) and the point at which it intersects the minor axis (g).

NOTE:- The minor axis must often be produced to cut in this point.

3rd. With ([illegible]) as a center and ([illegible]-f) as a radius, revolve (f) from ([illegible]-c), marking the position as (h).

4th. With ([illegible]-g) as a radius and ([illegible]) as a center, draw an arc intersecting ([illegible]-[illegible]), produced at (i).

5th. Draw the lines (g-f),(i-f), (g-h) and (h-i) and produce each indefinitely.

6th. With (g-a) as a radius and center at (g), draw an arc from (g-h) produced to (g-f) produced. Letter the intersection with (g-h), (j), and with (g-f), (k).

7th. With (i) as a center and radius (i-[illegible]) draw an arc, noting the point of intersection with (i-h) produced as (m), and with (i-f) produced as (l).

8th. With center (f) and radius (f-k) draw an arc. If the construction has been correctly carried out, this arc will pass through (d) and meet the point (l).

9th. With (h) as center and radius (h-j) draw another arc. This should pass through (c) and exactly meet the point (m).

10th. The curve (a-k-d-l-b-m-c-j-a) is the required approximate ellipse. Ink this curve in red, so that the points of departure from the ellipse of revolution, which is exact, may be noted.

11th. Ink construction in one quadrant only, so as not to confuse with Part I.

INSTRUCTIONS:- Problem 6--Part III.

1st. From ([illegible]) drop a perpendicular upon (c-[illegible]), lettering the base of this perpendicular (q) and its intersection with (c-[illegible]), ([illegible]).

2nd. In the same way drop a perpendicular from ([illegible]) upon ([illegible]-[illegible]), lettering the base (n) and its intersection with (c-[illegible]), ([illegible]).

3rd. From (o) drop perpendiculars upon (a-c) and (a-[illegible]), lettering their bases ([illegible]) and (p), respectively. If accuracy has been maintained, these last drawn perpendiculars will pass through points ([illegible]) and (s).

4th. With ([illegible]) as a center and radius ([illegible]-m), draw an arc from (n) to ([illegible]).

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5th. With (b) as a center and radius (b-r), draw an arc from (r) to (p).

6th. With ([illegible]) as a center, draw an arc connecting (p) and (n).

7th. With ([illegible]) as a center, draw an arc connecting ([illegible]) and ([illegible]).

8th. The required inscribed approximate ellipse is the smooth curve ([illegible]), and these points are the points of tangency.

QUESTION :- I-

What geometrical figure does any circular surface present when inclined to the plane of the observer's vision?

II-

How may an ellipse be constructed by means of two pins connected by a cord?

III-

What practical applications of the ellipse can you mention, first, in mechanical construction? Second, in the industrial arts?

Problem 9.

GIVEN :-

A hexagon inscribed in a circle of 1 1/4" radius. The center (o) to be ([illegible]).

REQUIRED:-

The transfer of the figure by means of co-ordinates, so that point (a) will fall at A; the transfer of the figure by means of angles, or polar co-ordinates, so that (b) will fall at B and finally; the transfer of the figure by means of parallels, so that (e) will fall at E.

Check:- Transfer point (c) in each of the above cases. With (c) as a center and radius (c-a), draw a circle. This should pass through the transferred positions of (a-b-c-d-e-f).

INSTRUCTIONS:- Problem No.9--Part I.

1st. Draw what is given of the problem in Fig. 2, Plate 6.

2nd. Locate point A (5 1/4"R-1[illegible] 1/2"D), B (2 3/8"R-11 1/2"D) and E (9 1/4"R-17"D).

3rd. Draw any line x-y (see Fig 2, Plate 6) and construct perpendiculars to it from each of the points (a,b,c,d,e,f, and g).

4th. Number the bases of these perpendiculars, as indicated, from 1 to 7.

5th. Through A draw a line of indefinite length parallel to (x-y) and lay off upon it the length of (1-2); point 2', the transferred position of 2, to fall below point A.

6th. At 2' erect a perpendicular to (A-2') and locate thereon the points 1', 3', 4', 5', 6' and 7', which must occupy the same relative posi-

tion to 2' that points 1 to 7 occupy with respect to point 2.

7th. At each of the points, 1' to 7', inclusive, erect a perpendicular of indefinite length.

8th. Upon the perpendicular at 1', lay off the length 1'-f' equal to 1-f; at 3', lay off 3'-e', equal to 3-e; at 4', lay off 4'-d', equal to 4-d, and continue this method for the remaining points.

9th. The lines (d'-f'), (f'-e') etc. will form an exact hexagon, which is that required in a foreshortened position by the co-ordinate method.

INSTRUCTIONS:- Problem No.3--Part II.

1st. From any point (z) outside the hexagon (see Fig 2, Plate G), draw lines to each of the important points of the figure.

2nd. Draw a line through B, parallel to (b-z) and lay off upon it the length (B-z'), equal to (b-z).

3rd. Now, with any convenient radius and with (z) and (z') as centers, construct arcs of indefinite length.

4th. Number the point of intersection of the arc drawn with (z) as a center, and the line (z-d), 8; with (z-c), 9; and with (z-f), 10;------ and with (z-e), 12. (See Fig.2, Plate G).

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5th. Lay off [illegible] ([illegible]), ([illegible]), ([illegible]),---- [illegible] ([illegible]), equal to ([illegible]), ([illegible]) etc. upon the arc drawn with [illegible] as a center, [illegible] the intersection of ([illegible]) with this arc.

6th. Draw the lines ([illegible]), ([illegible]), (10'-E') etc., [illegible] Lay off [illegible] ([illegible]), ([illegible]), ([illegible]), etc., [illegible] equal in length to ([illegible]), ([illegible]), ([illegible]), etc.

7th. Draw the lines ([illegible]), (B-[illegible]), ([illegible]), [illegible], ([illegible]) and ([illegible]). [illegible] [illegible] [illegible] [illegible].

Instructions:- [illegible]. [illegible] III.

1st. Before [illegible] with the last part of this problem, read carefully and [illegible] your [illegible] of the [illegible] of problem 5, plate 5.

2nd. Place [illegible] triangle [illegible] edge is in [illegible] (b-[illegible]), and move the second triangle [illegible] its free edge. This will act as a guide and will allow the first triangle to be moved, without turning, to such a position that [illegible] edge, first in contact with (b-[illegible]), will pass through ([illegible]). As the direction in which the first triangle may be moved is [illegible] the edge of the free [illegible] to [illegible] at the guiding triangle [illegible] this angle [illegible] be such as to make it impossible to [illegible], [illegible] in

contact with (e-f), to pass through E, it may be necessary to proceed as follows: First, select an edge that will allow the triangle to be moved in the right direction, then, using extreme care to keep the triangle from being moved from sliding, change the guiding triangle to the other face side, thus making possible its motion up or down to the required position, passing through (E). This will apply in any case where the above method of transferring lines is used.

3rd. After the line through (E) has been drawn, parallel to (e-f), as described above, locate a point (f') upon it, making (E-f')equal to( e-f).

4th. Proceed as in steps (2) and (3) to locate the points a', b', c', and d' with their connecting lines, which constitute the required hexagon transferred by parallels.

Check: Transfer the center (O) in each case by the same method as was employed for the other points. Draw a circle of the radius (O-a). This should pass through each of the transferred vertices.

QUESTIONS: I-

What practical application can you suggest for the methods of the above problem?

II-

How might such a figure, drawn to a scale of 1"= 100', be enlarged to full size, to a tract of ground? Which of the two methods would probably be most convenient and accurate, should it be used?

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Problem 10.

GIVEN:-

A circle of [illegible]" radius. Center (o) located [illegible]"D-[illegible]"L.

REQUIRED:-

The construction of six circles tangent to each other and to the large given circle by which they are to be inscribed. The construction of lines tangent to the large and small circles at their common point of tangency, these being extended to their point of intersection, thus forming a hexagon circumscribing the large circle.

INSTRUCTIONS: Problem 10,--Part I.

1st. Draw the horizontal and vertical diameters and sub-divide each quadrant into three equal angles.

2nd. Erect a perpendicular at the end of any of the lines which have been drawn, dividing the circle into twelve equal parts.

3rd. Extend this perpendicular until it intersects the adjacent line also produced and bisect the angle formed by the intersection of these lines.

4th. Extend this bisector until it intersects the line at the end of which the perpendicular was constructed. Letter this point X.

5th. With (o) as a center and radius (o-x)

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draw a circle (O), a radius from (A), letter every alternate point of intersection of this circle with the dividing lines, etc., (x). There will be six of these points in all.

6th. With a radius equal to the distance of any point, which has been lettered x, from the circumference of the given circle, draw six small circles, with each of these points (x) taken as a center. If the construction has been done with accuracy, these circles will be tangent to each other and to the given circle as required.

Note:- This method will hold true for any number of tangent circles, it only being necessary to remember that the large circle must be divided into twice as many sections as the required number of tangent circles.

INSTRUCTIONS:- Problem No.10--Part II.

1st. Number the points of tangency of the small circles from 1 to 6, inclusive.

2nd. Number the ends of the dividing lines from 7 to 12, inclusive, placing 7 between 1 and 2, 8 between 2 and 3, etc.

3rd. Erect a perpendicular to point 1, to the diameter (1-c) and extend it until it meets the diameters (c-7) and (c-11) produced. Number these points of intersection 7' and 11', respectively.

4th. Draw a line through points 2 and 7' and extend it to meet (c-8), produced. Number this point 8'.

5th. Continue this method for points 3,4,5, and 6. The result should be a perfect hexagon circumscribing the given circle.

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QUESTIONS:- I-

Have the principles of this problem any practical application? Give examples.

II-

Can the following problem be solved graphically by this means? Required the diameter of each of 10 roller bearings to roll within a collar of 5" diameter, with 1/8" clearance between adjacent bearings. Give reasons for your answer.

Problem No.11

GIVEN:-
A circle of one inch radius, with center (o), located (12"D-17 1/4"R).

REQUIRED:-
The construction of four spirals arranged symmetrically with respect to the horizontal and vertical diameters of the given circle.

INSTRUCTIONS: Problem No.11--Part I.

<u>1st.</u> Draw the horizontal and vertical diameters of the given circle and extend them indefinitely.

<u>2nd.</u> Divide each quadrant into three equal sectors and starting with point 1, as the upper end of the vertical diameter, number the ends of the radii, just drawn, from 1 to 12 in a clockwise direction.

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3rd. Draw tangents to the circle at each of the points 1 to 12 and extend them indefinitely in both directions. (Note:- A tangent is the perpendicular [illegible] at the end of any diameter).

4th. Lay off upon [illegible], the distances (1-[illegible]) and (1-[illegible]) [illegible], respectively, [illegible]. Number the points thus determined, [illegible].

5th. Lay off [illegible] at 12, [illegible] (1-2) and number the point obtained ([illegible]'). Also lay off [illegible] upon the tangent [illegible], an equal distance and number the point thus determined [illegible]'.

6th. Lay off [illegible] point 11, in the same general direction [illegible], three times the distance (1-2) and again number the point obtained (2'). Also lay off upon the tangent at point 3, in the same general direction as at 2, a distance equal to that just measured from 11. Number this point 12'.

7th. It will be seen [illegible], [illegible] point 1[illegible], [illegible] will form a curve, extending [illegible] and that another line, starting at ([illegible]) and connecting the points ([illegible]') will form a similar curve, extending to the left. Continue [illegible] until each curve, which is a spiral, has passed through 360 degrees or, in other words, until it has returned to its original [illegible]. Any two points consecutive upon the same tangent will be twelve unit distances apart, i.e. 12(1-[illegible]).

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NOTE:- It is only necessary to remember, in constructing these curves, that each succeeding tangent has the same unit lines of division out upon it that did the one just preceding it.

5th. Pencil in the two spirals [illegible]'---[illegible]' and 1[illegible]'---1[illegible]' and ink them by means of the French curves.

INSTRUCTIONS:- Problem [illegible],--Part II.

1st. Upon the [illegible] point 7 lay off to the right and left, respectively, the distances (7-8) and (7-[illegible]). Number the points, so determined, (8') and ([illegible]').

2nd. [illegible] ([illegible]) [illegible], [illegible] the tangent [illegible] ([illegible]), [illegible] distance, i.e. (7-[illegible]) or (7-[illegible]), [illegible] the points obtained 8' and [illegible]', respectively.

3rd. Complete the curves [illegible]'---[illegible]', and 9'----[illegible]', as in Part I of this problem.

NOTE:- In this problem, it is assumed that the [illegible] (1-2) along the [illegible] is equal to (1-2), along the [illegible]. This is only an approximation, but can be brought to any required degree of accuracy by increasing the number of divisions in the given figure.

QUESTIONS:- I-

Why will increasing the number of divisions in these problems, increase the accuracy?

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II-

Has the spiral any practical application in mechanical construction or industrial arts?

III-

How may a spiral be drawn with a pencil and cord?

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THIRD SEMESTER.

Before entering upon the construction of Plate C, and those succeeding it in Course III., it will be necessary for the student to give a great deal of careful study to the Frontispiece of this book. In this drawing, the author has shown a typical example of what will be expected in the remaining plates of the semester's drafting, and during the remainder of the course, repeated reference should be made thereto for hints as to the best methods of procedure.

To understand this plate and to apply it to the best advantage, the following outline will be found indispensable.

I-

(Isometric Method)

The isometric drawing is often called a "Mechanical painting or perspective view". It always appears "out of drawing", because all the lines are

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parallel to the object itself, and to be parallel to the T-square, usually with the 30 degree triangle, instead of converging to [illegible] called the "vanishing point", as in the case of perspective. These conventions [illegible] be explained thoroughly in the [illegible] Course [illegible], [illegible] large items in projective drawing [illegible], it will [illegible] the "[illegible]" method in place of perspective [illegible], [illegible] single and rapid [illegible] the purpose [illegible] by [illegible]. In [illegible] sketch called [illegible] free-hand sketch [illegible] isometric given by [illegible] by [illegible] triangle. The [illegible] be use-

ed in pencil [illegible] finished drawing, [illegible] [illegible] by the instructor. The proportions of these drawings in Course [illegible] are to be obtained by "eye" [illegible] not by scaling [illegible] the given drawing in the text.

II-

Orthographic,
or
Perpendicular Projection.

Of course, it is understood that all solids have three dimensions, viz. length, breadth, and depth or thickness. All of these are shown in one [illegible] perspective drawing. [illegible], however, [illegible] [illegible], [illegible] necessary to show all the [illegible].

In [illegible], [illegible] [illegible] [illegible], [illegible] [illegible], [illegible] vertical [illegible].

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conception of [illegible] by [illegible] supposing that "vertical dimensions [illegible]" in the plan view, let him hold the T-square in a vertical position and, [illegible] his eye direct-ly above and over [illegible], [illegible] sighting along it. In this present position, the upper and low-er points of the edge, as well as all the inter-mediate points, will appear [illegible] into a single point at the upper end of the blade.

If the observer lift[illegible] to the line of head or length of blade of the T-square as in holding, he would be unable [illegible] of their dimensions from this present view point, for the head might be [illegible] the eye, the [illegible] end at a considerable distance from it, with the same visual effect, as [illegible] dimension, in any case, would appear as a point.

In the front view, length and depth appear in their true proportions, but breadth disappears,

since all of the lines of width now appear as points. This is because the eye of the observer is supposed to have shifted its position so as to be looking straight ahead along every line of width, instead of straight down upon all the vertical lines as in the plan view.

In the side view, or profile, the breadth and depth appear in actual size, but in this case, the lines of length appear as points.

The form of projection explained above is known as "orthographic" or "perpendicular" projection. A great deal of thought and careful study will be required before any proficiency may be hoped for in its use. The student must understand that the various views of a set of "working drawings" are not such as would ever appear to the eye looking upon the object they represent. They are purely theoretical in this respect and either consider the observer at an

infinite distance from the object, so that the rays of light reflected from it come in parallels, or that the eye is assumed to occupy an infinite number of positions simultaneously, one position directly above every projected point of the object, as in the case of the T-square experiment for a single point.

III-
(Arrangement of Views)

Since any two views have one dimension in common, i.e. the plan and side views have width; the front and side views have height; and the plan and front views have length; they are so placed that this common dimension may be readily projected, by vertical or horizontal projection lines, from one view to another.

Notice, in the typical drawing under consideration, that the front view lies, point for point, vertically below the plan; that the side and front views have their common points in the

same horizontal lines, and that the corresponding points of the plan and side views are projected in such a manner as to hold the points of width in the same relative position at all times.

IV-
(Axes of Projection)

The views will be seen to be separated by a horizontal and a vertical line which are known as the "axes of projection". The theory of their derivation, together with a much more extended and comprehensive discussion of projection, will be found in Course D2 and those courses succeeding it, but for the present, these lines will be regarded simply as the boundaries of the various views to which the projection lines are either perpendicular or parallel.

Let a small scale drawing, showing the most important lines of each of the views, be made at this time upon a sheet of practice paper.

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Cut from this the quadrant containing the circular arcs and fold along the axes of projection. The plan, front, and side views will occupy planes that are perpendicular to each other, the plan view being horizontal and the front and profile views vertical in position. It should now be clear to the student that each of the views represents a perpendicular projection from an imaginary sewing table, which is supposedly standing back of the vertical planes and below the horizontal.

V-
(Broken or Dotted Lines)

It should next be noted that certain lines, not visible because of intervening surfaces, must be shown. These lines are drawn "dotted" or "broken" (See Plate 2, line C) Care should be exercised in the use of these lines, for in attempting to indicate the position of all con-

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cealed parts, we may [illegible] that a meaningless network will [illegible] the result. Take, for example, the plan view in the plate under discussion: since the table top covers all the construction below it, with the exception of the tip ends of the drawer pulls, if these parts are to be indicated, they must be shown as dotted lines.

Now, in the left one-half of this view, the author has [illegible] the upper [illegible] pedestal, the cabinet, [illegible], [illegible] drawer [illegible]; in the lower right-hand corner, he has indicated the lower [illegible] pedestal, [illegible], and [illegible]; [illegible] upper right-hand corner, [illegible] dotted lines, [illegible], drawer, leaf support [illegible]. Is it not evident that if all of these [illegible]? See [illegible]

make some point clearer to those who will later have the task of constructing the finished article from your design.

The dotted line is also used frequently to indicate a possible position that a movable part may occupy as, for instance, the table leaf in this problem. In the front view, it will be noted that the leaf at the left is down; but that its position, when up, is indicated by dotted lines in this and the plan view as well. At the right, the leaf is raised, but its position when lowered is indicated in the same manner.

VI-
(Sectional Elevation)

Perhaps no other one form of drawing is capable of imparting as much information as the "sectional elevation". To understand the theory of its construction, it is only necessary to think of one quarter of the object as cut away,

leaving exposed all of its construction along one-half of the longitudinal and transverse axes.

Again, reference to the plate, will show that the portion of the table shown in the lower right-hand quarter of the plate, is to be considered removed in that position and that, as a result, the drawer, pedestal, cabinet, top and base construction are clearly shown. Cross sections are often taken along lines other than the axes of the figure, but they are always so taken unless there is some special reason for shifting them to another position.

VII-

(Cross-Hatching or Hatch-Lining)

It is customary to indicate the fact that a member or members of a structure have been cut by a plane, as described in the 6th section of this discussion, by the use of a series of lines drawn across the exposed areas. This is called

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"cross-hatching or hatch-lining". In case the project is constructed entirely of one material, such as wood, for example, then the various pieces are set off from one another by not repeating the angle of lines in the adjacent pieces. Where different materials, such as iron, brass, rubber, etc. are used in the construction, different "section-lines" are employed to indicate these substances, i.e. the convention for brass is a series of light broken and solid lines, used alternately; for wrought iron, a light and heavy line, used alternately; for rubber, a series of very heavy lines, drawn closely, etc.

Inquiry will, probably, be made as to the reason for omitting the hatch-lines from the brace under the table top, as it lies directly upon the center line and is, therefore, cut its entire length by the section plane we are con-

A Mechanical Course In [illegible] Schools.

sidering. All [illegible], [illegible] it is customary [illegible] - ment [illegible] - [illegible], etc. With [illegible] the [illegible], the student [illegible] through repet- ition.

VIII-
([illegible].)

A drawing, [illegible], does not only [illegible], [illegible] of [illegible] - ous [illegible]. Should a bridge fall [illegible], [illegible], to their death, [illegible] will be [illegible] " [illegible] " [illegible] "[illegible]" [illegible] " [illegible] drawings?

[illegible]

[illegible]

[illegible] acquired [illegible]

[illegible]

Whenever possible, make dimensions in [illegible]

[illegible]

[illegible]

have been made [illegible]. Take time at first and it will not be long until you are making excellent figures as rapidly as you formerly made those that were illegible.

Always [illegible] so that they may be read from [illegible] side of the [illegible]. It should never be necessary [illegible] up [illegible] side toward the reader.

In the [illegible] " [illegible] " dimensioning, [illegible] necessary [illegible]. Di- [illegible] in the "D [illegible]". All [illegible] should be given [illegible] in [illegible], [illegible] to [illegible] will [illegible]. [illegible] lines [illegible] points [illegible] the extension lines.

# A Mechanical Course For High Schools.

## I-
## Lettering.

Lettering should be done freehand [illegible] ed [illegible] the plate neatly planned in advance, so that crowding will be unnecessary and that drawing of extension lines, etc. through the lettering may be avoided.

## II-
## (Projection Lines)

Show only the most important projection lines, remembering that center lines may be shown with a [illegible] and dash and projection lines with two dots and dash. (See Plate I).

## III-
## (Center Lines)
## or
## (Axes of Figure)

As a rule these lines should be the first drawn, as in this way the location of each view may be quickly determined and parallel lines of

[illegible]

-II-
Scale.
Mechanical Drawing [illegible].

[illegible] scale, [illegible] [illegible]

1/" scale [illegible]

themselves while for details the 3/4", 1 1/2", 3", and 6" scales are most frequently employed. The choosing of a scale at any time requires some little computation, and for the first one or two plates some help from the instructor may be necessary.

NOTE:- Before beginning the drafting of any of the plates, No. 6 to No. [illegible], inclusive, study the detailed drawings of the same problems, as shown by the author in Shop Course 51, for possible suggestions.

QUESTIONS:-

To satisfy himself that he has the foregoing article well enough in mind to proceed with the drafting of Plate 6, Course D1, let the student answer the following questions in writing:

I-

How are you to proceed with the [illegible] Shop Sketch?

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II-

How are the axes of projection to be drawn [illegible] or the instruments [illegible] give you the location of their point of intersection?

III-

What lines of each view are first drawn?

IV-

How will you decide upon the scale to be employed?

V-

What position does the plan view occupy with respect to the axes of projection?

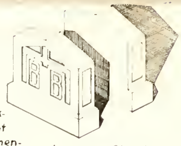
VI-

What position does the front view occupy with respect to the axes of projection? To the plan view?

VII-

What position does the side view, or profile, occupy with respect to the axes of pro-

Prob 12. BOOK BLOCKS.



Isometric Sketch

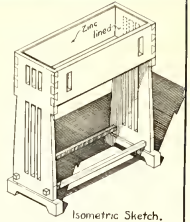
**Given.** An isometric sketch of book blocks or of optional problem number one.

**Required.**
The making of free-hand sketch of isometric here shown; also the making of working drawings in plan, front view, and side view, these to be dimensioned to conform to proportions of sketch.

**Instructions.**
Place the point of intersection of the horizontal and vertical axes of projection [See Foot Note]

**Questions.**
Which lines of the sketch will be foreshortened in the plan view? Which in the front view? Which in the side view?
What relative position must a line and a plane occupy in order that the projection of the line upon the plane be equal to the line?

Prob 14 FERN BOX.




Isometric Sketch.

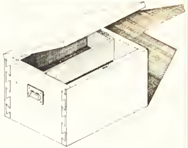
**Given** Isometric Sketch of a fern box.

**Required.**
Same requirements as in preceding problems.

**Instructions.**
Place the point of intersection of the horizontal and vertical axes [See Foot Note]

**Questions.**
What other types of joint could be used in place of the dovetail in this and the preceding problem?
Why is zinc a satisfactory metal to use in places where water is to be retained? What other metals also resist corrosion and, for this reason, are largely used in the building trades?

Prob. 13. SMALL TOOL CHEST.



Isometric Sketch

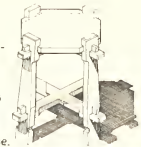
**Given** Isometric sketch of tool chest.

**Required.**
Same as in preceding problem.

**Instructions.**
Place the point of intersection of the horizontal and vertical axes [See Foot Note]

**Questions.**
How many times as large is 1in., to a scale of 4in per foot, as it is to a scale of $\frac{1}{4}$in. per foot?
What is meant by the term DETAIL? Is it more convenient to show detail in large or small scale drawings?
What is meant by an ISOMETRIC DRAWING? Why is it that isometric drawings always seem more or less distorted?

Prob 15. TABOURETTE.



Isometric Sketch

**Given.** Isometric Sketch of tabourette or of optional problem number two.

**Required.**
The same as in all other problems of this plate. It is also required that the pupil at the completion of the problems make a complete bill of material for each exercise.

**Instructions.**
Place the point of intersection of the vertical and horizontal axes [See Foot Note]

**Questions.**
What are the characteristics of the mission and craftsman styles of furniture and architectural design?

NOTE. *PLATE No. 6 IS TO CONSIST OF TWO PROBLEMS; THE FIRST TO BE A CHOICE OF PROB. 12 OR 13 AND THE SECOND EITHER PROB. 14 OR 15. WHEN THE PUPIL HAS DECIDED UPON HIS PROBLEMS, THE INSTRUCTOR WILL SUPPLY OMITTED INSTRUCTION DATA.*

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|---|---|---|
| PLATE H. | MECHANICAL DRAWING. COURSE D.1 | DRAWN BY R.A.Perkins |

jection? With respect to the plan view? With respect to the front view?

VIII-

Having located a certain point in the plan view, how would you proceed to find the point, or line, which it represents, in the front and side views?

IX-

How would a vertical line be shown in the plan view? A line of width in the front view? A line of length in the side view?

X-

Why are practical drawings made in projection? What advantages have they over the simple elevation? [illegible] plane?

Plate No. [illegible].

In Plate [illegible], Column [illegible], [illegible] must be chosen for the

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problems of Plate 7, as specified at the bottom of the plate. It must be remembered that the practical object [illegible] will be the first one made in Shop 11.

INSTRUCTIONS: Problem 11.

If problem [illegible] is shown, it will be [illegible] of rectangles, having [illegible] side at the back.

Place the long dimension of the view, i.e. the longitudinal axis, parallel to the horizontal edge of the sheet.

Draw first the plan view, second the front view, and finally, derive the side view by projection from the first two views as [illegible].
Dimension completely.

NOTE:- See explanation of optional Problem No. I, page........

A Mechanical Course for High Schools.

## Problem 13.

In this problem all the surfaces will be rectangular. As in Problem 12, place the longitudinal axis, of the pile, parallel to the horizontal axis of projection.

If this problem is [illegible], [illegible] for it [illegible] the [illegible] orthographic.

[illegible] of [illegible] angles of [illegible], [illegible], [illegible].

Dimensions on plate.

## Problem 14.

Again the plane [illegible] rectangular [illegible] the long dimension is to be placed parallel to the horizontal axis.

In this problem, the [illegible] to proceed will be [illegible] the plan, [illegible]; the side; and finally, the [illegible] by projection from these. Dimensions on plate.

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Problem IV.

In making this drawing it will be necessary for the sake of simplicity and [illegible] as to proceed as follows:

1st. Draw a square, of the required size, in the plan, making its diagonals parallel, respectively, to the horizontal and vertical axes of projection.

2nd. Cut the corners perpendicular to the diagonals, so that ample space for the base of the silhouette will be afforded.

3rd. After finishing this part of the plan construction, leave it for the time being, and, using the information it affords, complete the design of the front elevation.

4th. Return to the plan and, after its completion, derive the side elevation by projection.

Note: See explanation of Optional Problem No. II, Page..........

Prob. 16. DRAWING TABLE.

GIVEN.

The isometric of a drawing table.

REQUIRED.

The drawing of the sketch and the dimensioning of same, also the making of working drawings in plan, front, and side views. It is further required that the principle parts be detailed and dimensioned.

INSTRUCTIONS.

Place the point of intersection of the axes of projection [See Foot Note]

QUESTIONS AND SUGGESTIONS FOR SUPPLEMENTARY STUDY.

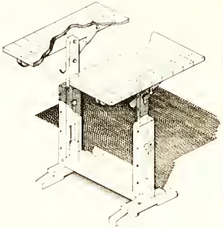
What are jigs?

What are templets?

Explain in a short report, illustrated with free-hand sketches, how a set of templets and jigs could be made to aid in the rapid construction of a set of tables like the above isometric. Would it pay to construct a set of jigs to build one or two tables only?

Does lumber show the greatest shrinkage and expansion, due to a variation in the amount of maisture in the wood, in the direction of the grain or across it? On this account what devices are made use of in attaching table tops, like the above, to the transverse supports?

Make complete bill of material required for above drafting table, and also specify the most satisfactory wood and finish for each of the parts. What would be the cost of this material figured at local prices?



Isometric Sketch.

Prob 17. FOLDING SCREEN.

GIVEN

The isometric of folding screen or of serving table shown in optional sketch number three

REQUIRED

A free-hand drawing of the problem and the making of working drawings for same in plan, front, and side views. It is also required that, at the completion of the plate, a complete bill of materials be made. Detail completely.

INSTRUCTIONS.

Place the point of intersection of the axes – [See Foot Note.] If the screen is chosen by the student, let the middle section be placed parallel to the vertical plane of projection, the other two sections being inclined 30° right and left respectively. [See Plan View below]

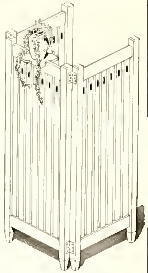
QUESTIONS FOR SUPPLEMENTARY STUDY.

What are acid stains, water stains, and oil stains? What advantages has each?

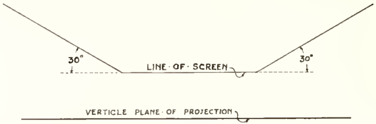
What are paste fillers and liquid fillers? Why are they used?

What is varnish? Shellac? Wax? How and why is each used?

What inexpensive woods, by the use of stains, may be quite satisfactorily substituted for mahogany, Circassian walnut, etc.?



Isometric Sketch.




PLAN VIEW.

NOTE. PLATE No. 7 IS TO CONSIST OF ONE PROBLEM; PROB. 16, PROB. 17, OR OPTIONAL PROB. 3. WHEN THE PUPIL HAS DECIDED UPON HIS PROBLEM, THE DATA OMITTED FROM "INSTRUCTIONS" WILL BE SUPPLIED BY THE INSTRUCTOR.

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|---|---|---|
| PLATE I | MECHNICAL DRAWING. COURSE D.1. | DRAWN BY R.A.Perkins |

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Plate No. V.

This plate is to consist of [illegible] problems as specified in Plate No. V, Course D1. The construction of [illegible] project will constitute the last drawing in Course D1, and, therefore, the project should be [illegible] only after careful consideration.

The [illegible] should have given sufficient preparation for plate V so that no further [illegible] will be necessary.

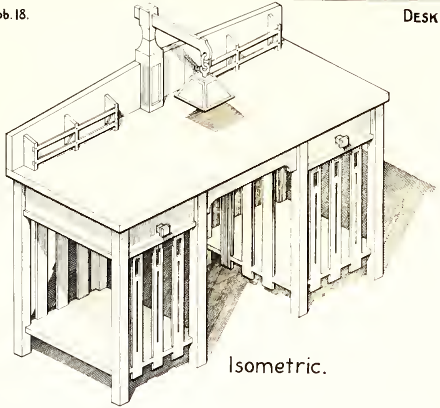
Plates Nos. [illegible] and [illegible].

A choice of two problems is offered for this plate [illegible], or the problem of plate [illegible], [illegible] of the [illegible] Course D1.

Each individual [illegible] given by [illegible] will be [illegible] of this plate

Prob. 18.

## DESK WITH LIGHT.



Isometric.

GIVEN:-Isometric drawing of desk or of optional problem number four.

REQ:-Working drawings in plan, front, and side views; also complete details.

INSTRUCTIONS:-Place the point of intersection of the horizontal and vertical axes [See Foot Note]

QUESTIONS:-What is meant by the following terms:

Quarter-sawed, flat-sawed, and edge-grained? Which of these may be produced only by considerable waste of material? Which method of production will insure the highest market price?

What would be the cost of desk if made of flat-sawed red oak? Quarter-sawed white oak? Flat-sawed white oak?

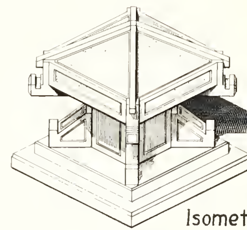
Prob. 19.

## TABLE LAMP FOR HALL.

GIVEN:-Isometric of hall lamp or of optional problem number six.

REQ:- The drawing of sketch of the problem chosen, also the making of working drawings in plan, front, and side views, and complete details. Make bill of material and figure cost of same.

INSTRUCTIONS:- Place the point of intersection of the axes of projection [See Foot Note]



Isometric.

NOTE. The solution of Prob. 18, Prob. 19, Optional Prob. IV, or Optional Prob. VI will constitute the work of this plate. When the problem has been selected, the teacher will supply the missing data in "INSTRUCTIONS."

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| PLATE | MECHANICAL DRAWING. COURSE D1. | DRAWN BY |
|---|---|---|
| J. | | R.A. Perkins |

A Theoretical Course in [illegible] High School.

and plate No. nine. If the [illegible] problems have [illegible], all the difficulty should be experienced in [illegible].

[illegible].

Problem No. I

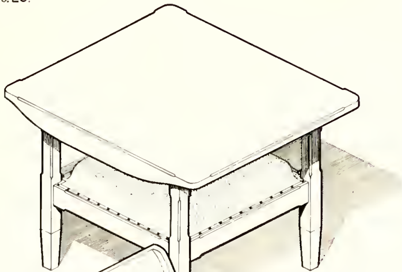
In this problem, the [illegible] rectangle, [illegible] inclined axis, i. e. the center line [illegible] parallel to [illegible].

[illegible] the object in [illegible], [illegible] cessary to leave [illegible], [illegible] the top is inclined to [illegible].

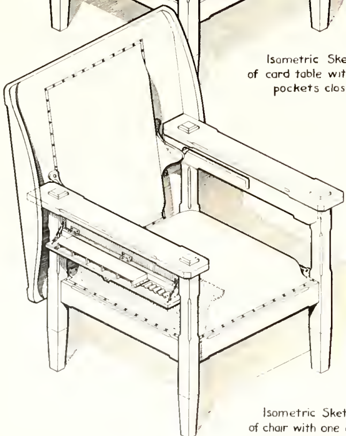
After completing [illegible], [illegible] the [illegible] vertical [illegible] been [illegible].

Prob. 20.

## COMBINATION CHAIR AND TABLE.



Isometric Sketch of card table with arm pockets closed.

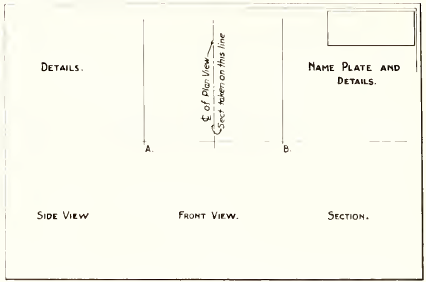


Isometric Sketch of chair with one of the arm pockets open.

GIVEN:- Isometric drawings of convertable table and chair.

REQ:- The making of working drawings of the above problem in plan, front, and side views, transverse section and details.

INSTRUCTIONS:- Place the points of intersection of the axes of projection, A and B of the figure, $8\frac{1}{2}$"D-8"R and $8\frac{1}{2}$"D-16"R respectively. Arrange Plate No.9 as indicated above.




The shop sketch of this problem will be included on plate with bill of material and estimate of cost.

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| PLATE ·K· | MECHANICAL DRAWING COURSE D1 | DRAWN ·BY R·A·P |
|---|---|---|

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Problem No. 71.

Two concentric circles will constitute the main feature of [illegible], [illegible] and the [illegible] being dotted therein. The [illegible] placed [illegible] projection.

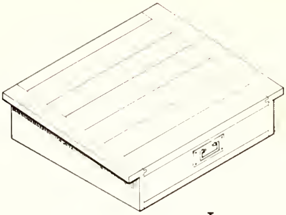
Draw first the [illegible] circles, and then [illegible] through the [illegible] which will represent the upper ends of the legs. From this view [illegible] this point out, using the [illegible] which it provides, finish completely the [illegible]. The top of the stool, in the front and side views will appear [illegible] with the upper [illegible] chamfered, [illegible] line connecting [illegible] should be [illegible]. Why?

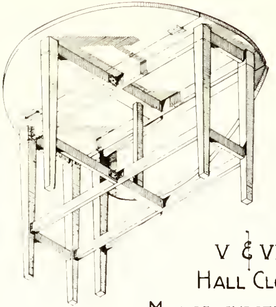
Having completed the [illegible], [illegible] the plan and supply the lines missing therefrom.

Finally, construct the side view by projection from the plan [illegible] elevation. The

III.

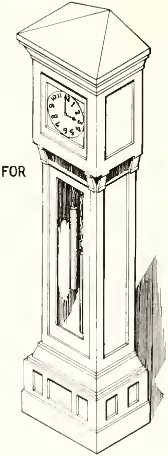
Serving Table.
May be substituted
for regular
Prob. 17





I.

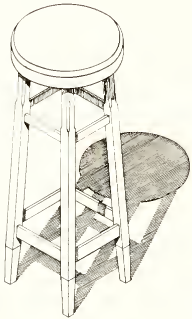
Drawing-board with Drawer.
for use upon common table for home work.
May be substituted for regular problem No. 12

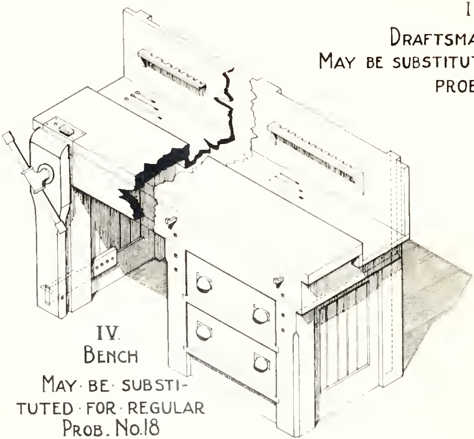


V & VI
Hall Clock
May be substituted for
Prob. 16 or Prob. 19.

II.

Draftsman's Stool.
May be substituted for regular
Prob. No. 15





IV.
Bench
May be substituted for regular
Prob. No. 18

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|---|---|---|
| Plate L | Optional Problems. Course D1 | Drawn by R. A. Perkins |

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difference appears between the [illegible] views?

Problems III, IV, V, and VI.

No special instruction should be necessary for the handling of these problems in any [illegible], the student [illegible] to analyze the difficulties presented.

The [illegible] of these problems [illegible], respectively, [illegible] of [illegible] for which they are [illegible].

BOOK III.

[illegible] III.

[illegible]

[illegible]

# VASES

THESE MAY BE USED AS THE LAST EXERCISE OF S3 AND FOR PLATE 2 D2 WHERE SUBSTITUTE PROBLEMS ARE DESIRED.

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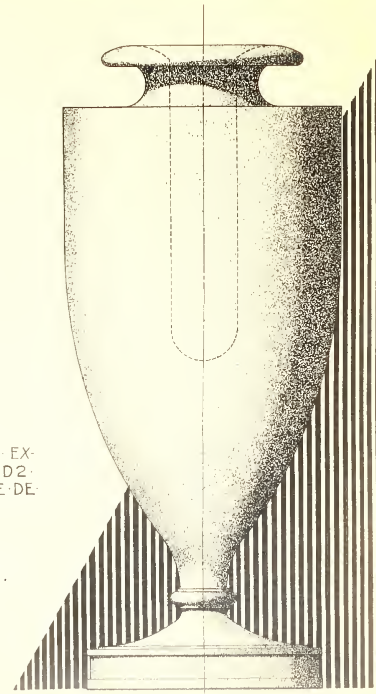
FRONTIS-PIECE MECHANICAL DRAWING
COURSE D2



[illegible]

[illegible].

[illegible].

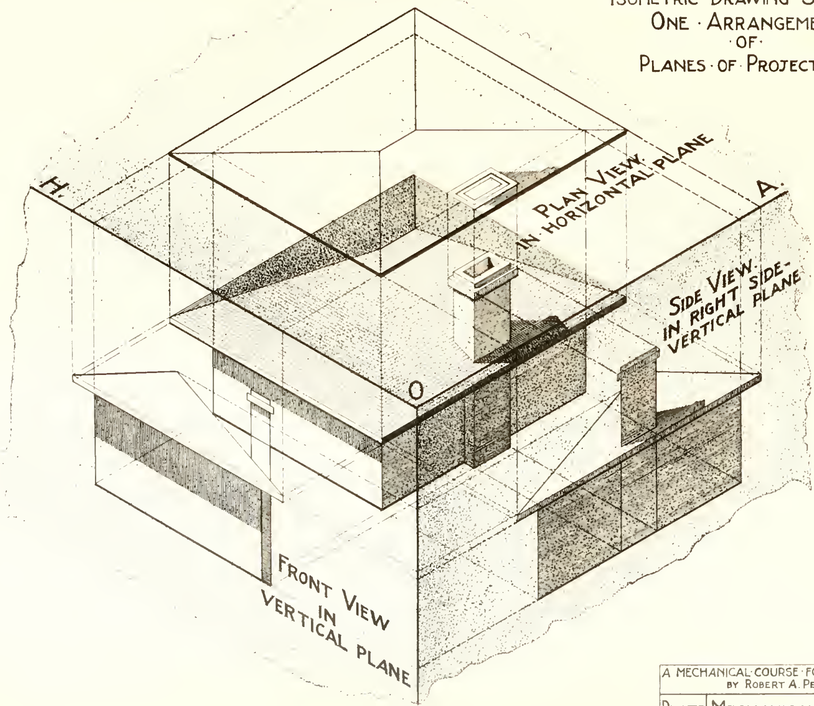
In [illegible] [illegible] "[illegible] ic projection" [illegible] [illegible]

1.

(Pl[illegible])

[illegible]

ISOMETRIC · DRAWING · SHOWING
ONE · ARRANGEMENT
· OF ·
PLANES · OF · PROJECTION ·




| | | |
|---|---|---|
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| PLATE A. | MECHANICAL DRAWING COURSE D2. | DRAWN · BY · R.A. Perkins |

ure. The complete set of projections [illegible] horizontal plane [illegible] what is known as the "plan view" of the object; on the vertical plane, the "[illegible] view"; and on the side vertical plane, the "side view" or "profile."

IV-

([illegible])

[illegible]

[illegible]

[illegible]

| | | |
|---|---|---|
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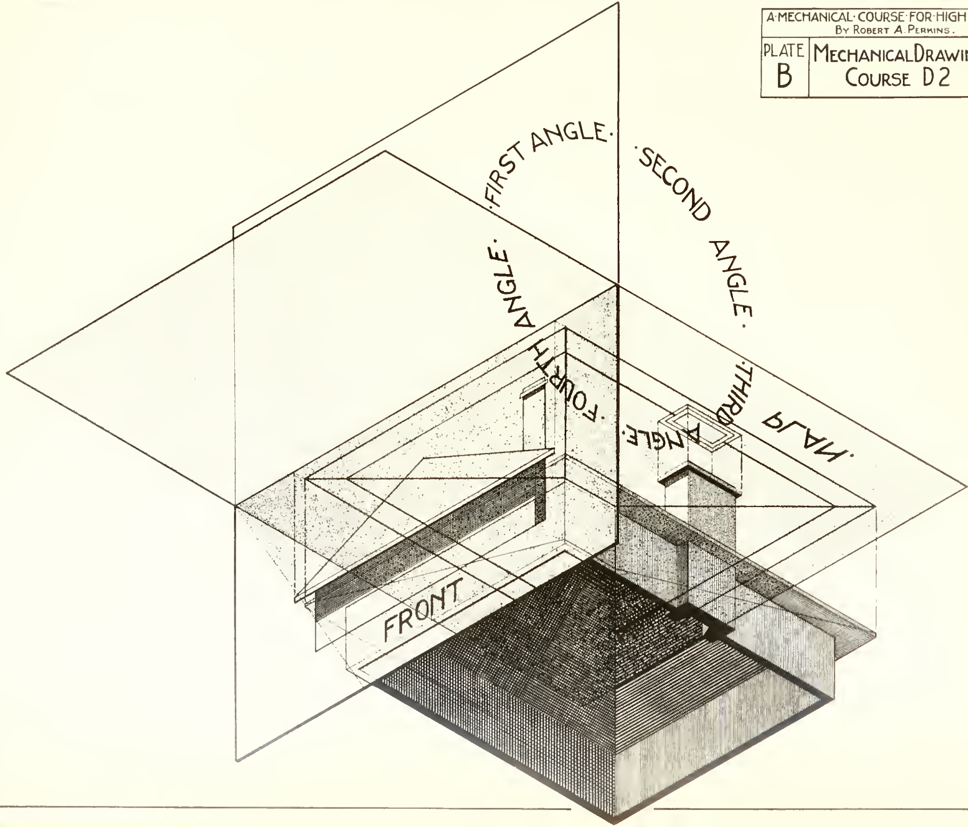
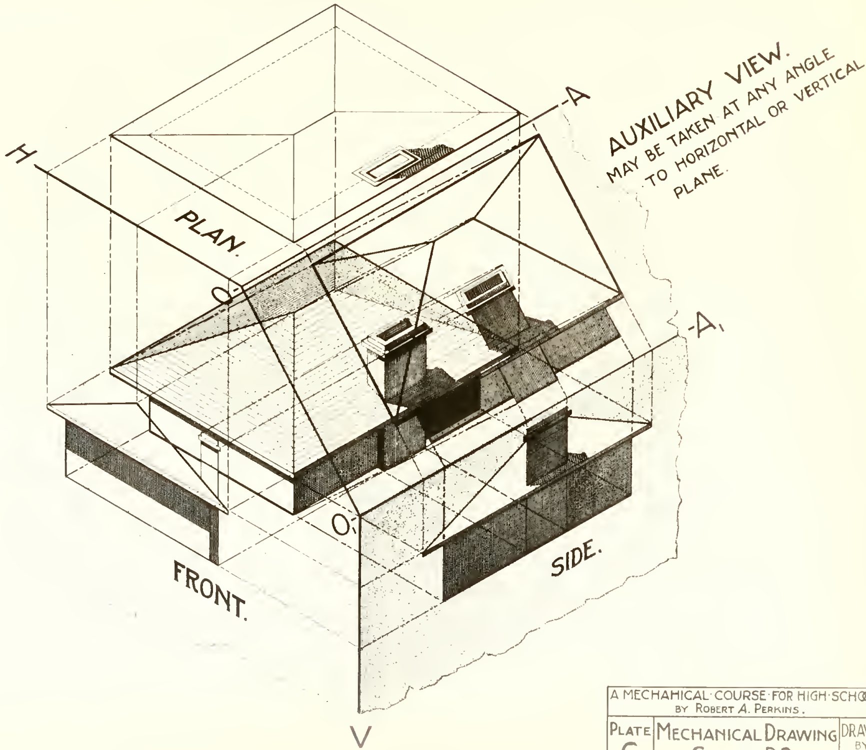
| PLATE B | MechanicalDrawing. Course D2 | Drawn ·By· R.A.Perkins |



[illegible] ". [illegible]
[illegible]
[illegible] Plate D [illegible]
[illegible], [illegible]
[illegible]
[illegible] planes [illegible], [illegible]
[illegible]
[illegible], [illegible]. In [illegible]
[illegible] drawing [illegible]
[illegible] parallel [illegible]
[illegible] planes [illegible],
[illegible], [illegible], [illegible]
[illegible] vertical planes [illegible] outline.

VI-
(Auxiliary Planes.)

In Plate 6, [illegible]
[illegible] to be in the
[illegible]
[illegible]
[illegible] perspective, [illegible].




| | | |
|---|---|---|
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| PLATE C | MECHANICAL DRAWING COURSE D2. | DRAWN BY R.A.Perkins |

[illegible]

[illegible] [illegible].

VII-
[illegible]

[illegible], [illegible]; [illegible], [illegible] in Plate D and E; [illegible] [illegible], [illegible] Plate C [illegible]. [illegible] in the following [illegible]? [illegible]? [illegible]?

VIII-
[illegible]
[illegible].

The [illegible] [illegible].

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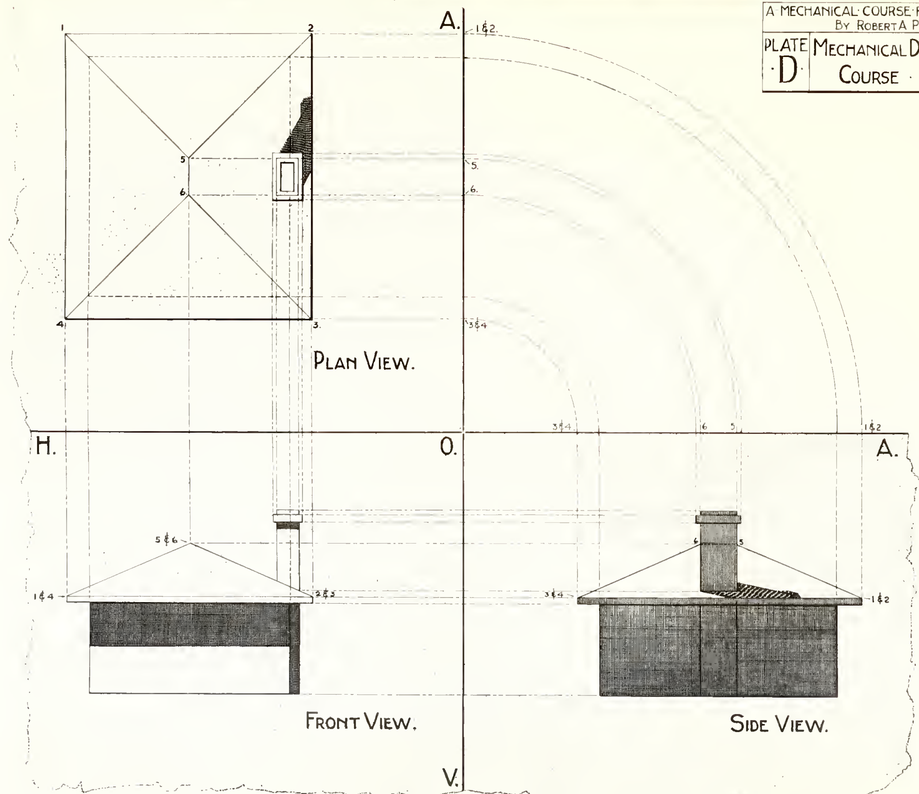
|---|---|---|
| PLATE<br>·D· | MECHANICAL DRAWING.<br>COURSE · D2 | DRAWN<br>·BY·<br>R.A.Perkins |



A Mechanical Course For High Schools.

If the student [illegible] syllabus [illegible] tion, then [illegible] a [illegible] ly [illegible] mentally [illegible] ally [illegible] the [illegible] of projection [illegible] the [illegible] of his [illegible]. Much careful study [illegible] spent upon the [illegible] for a thorough [illegible] the [illegible].

The [illegible] the work [illegible] following [illegible] will be [illegible]:

[illegible]

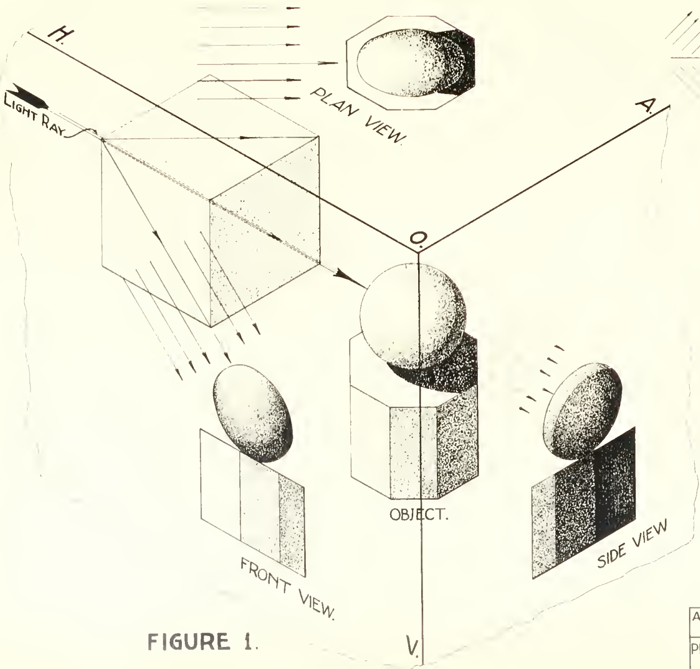



FIGURE 1.

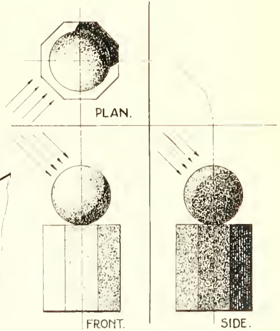


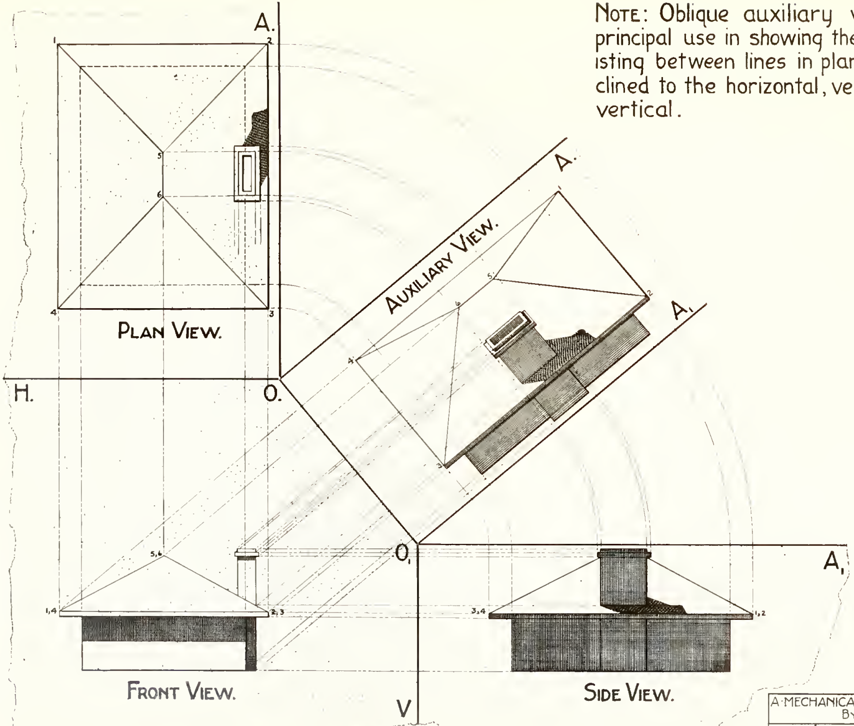

FIG. 2.

## ILLUMINATION

See text for explanation of this plate.

| | | |
|---|---|---|
| A·MECHANICAL·COURSE FOR·HIGH·SCHOOLS. BY·ROBERT A.PERKINS. | | |
| PLATE F | MECHANICAL DRAWING. COURSE D2. | DRAWN ·BY· RAPerkins |

NOTE: Oblique auxiliary views find their principal use in showing the true relation existing between lines in planes which are inclined to the horizontal, vertical, and side-vertical.




A·MECHANICAL·COURSE·FOR·HIGH SCHOOLS.
BY ROBERT A PERKINS.

| PLATE | MECHANICAL DRAWING | DRAWN BY |
|---|---|---|
| E | COURSE D2. | RA Perkins |

[illegible].

[illegible] should [illegible] this [illegible].

[illegible], [illegible]

[illegible]:-

I-

[illegible] these [illegible]?

II-

Why does [illegible]?

[illegible]

III-

In a [illegible] [illegible]

IV-

In [illegible]

V-

[illegible]

VI-

[illegible]

VII-

[illegible]

VIII-

[illegible]

[illegible]

A Mechanical Course for High Schools.

II-

[illegible] which was [illegible] the object in mechanical [illegible] than forty-five degrees? [illegible] of [illegible] ly.

[illegible]

Of [illegible] which was the [illegible]? [illegible] determine the [illegible]?

[illegible]

[illegible]

[illegible] Course [illegible]. As they [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

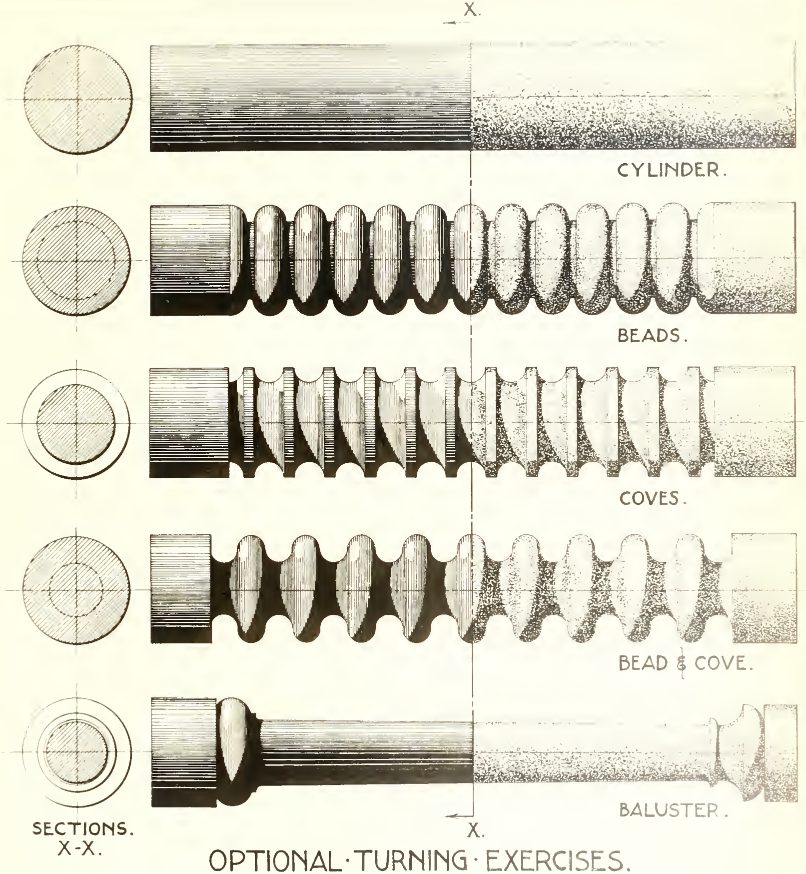
[illegible]

[illegible]

[illegible]

[illegible]

[illegible]




OPTIONAL·TURNING·EXERCISES.

MAY·BE·SUBSTITUTED·SINGLY, OR·AS·A·GROUP, FOR·THOSE·CORRESPONDING·IN·PL. G.

A Mechanical Course For High School.

The choice of problems should contain either a pulley, [illegible] Fig. 3, [illegible] will vary [illegible] [illegible] exercises, [illegible], [illegible] and [illegible]; [illegible] pulley, [illegible]. Another [illegible] would be the pulley, with the [illegible] exercises.

(NOTE:- [illegible], and plates illustrating [illegible] possible suggestions.)

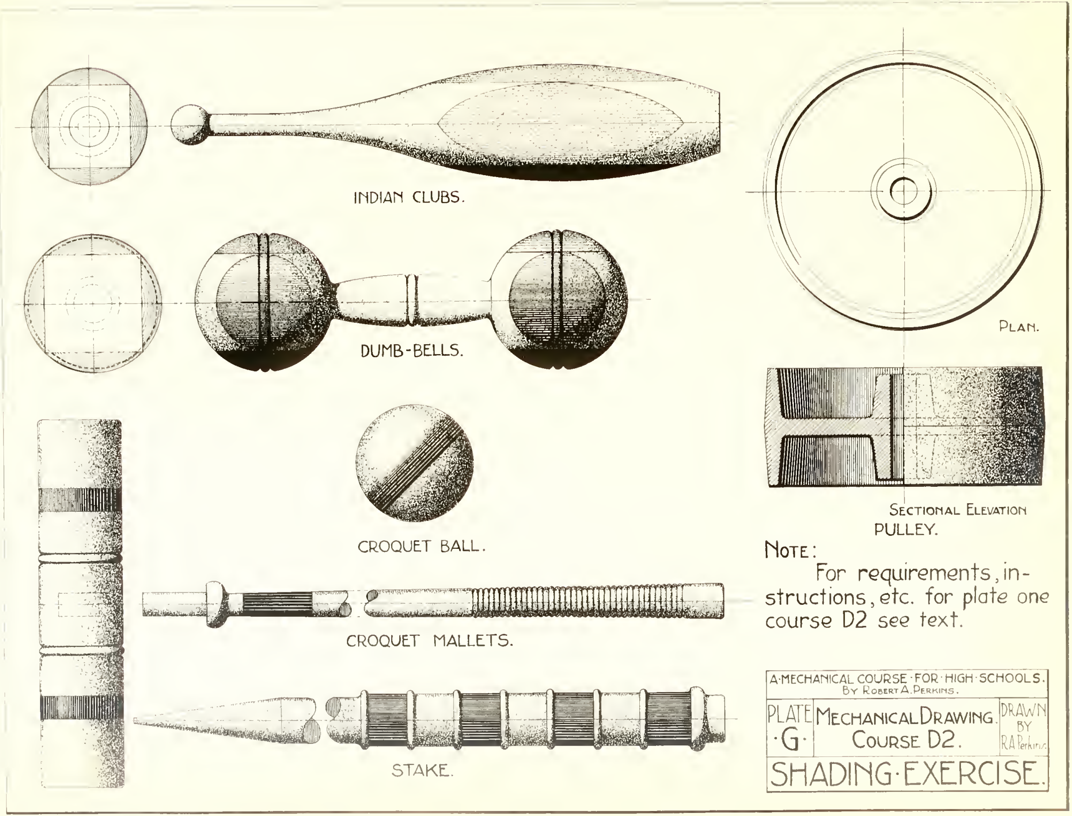
INSTRUCTIONS:-

1st. [illegible] of Course DI ([illegible], [illegible].

2nd. Make a [illegible] upon scratch paper, [illegible].

3rd. After [illegible] the instructor, [illegible]; [illegible].

4th. Complete [illegible], giving complete [illegible].


INDIAN CLUBS.
DUMB-BELLS.
PLAN.
SECTIONAL ELEVATION
PULLEY.
CROQUET BALL.
NOTE:
For requirements, instructions, etc. for plate one course D2 see text.
CROQUET MALLETS.
STAKE.
A·MECHANICAL COURSE·FOR·HIGH·SCHOOLS.
BY ROBERT A. PERKINS.
PLATE ·G·
MECHANICAL DRAWING. COURSE D2.
DRAWN BY R.A.Perkins.
SHADING·EXERCISE.

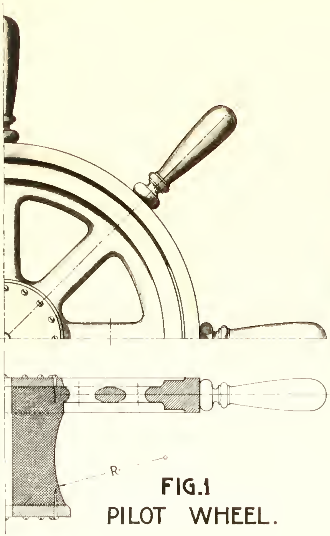



FIG.1
PILOT WHEEL.

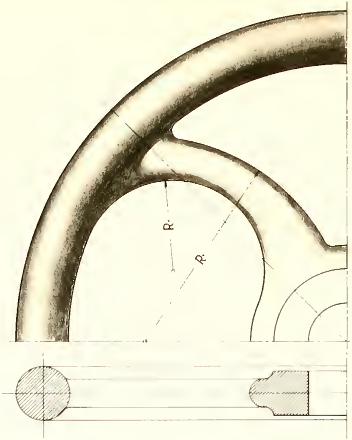



FIG.2
BALANCE WHEEL

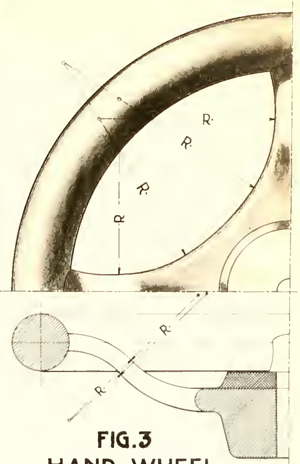



FIG.3
HAND WHEEL

NOTE: Plate two, of this course, will consist of plan, elevations, sections, and details of one of the above wheels rendered in flat washes. The wheel designed will be constructed as last exercise of Course S3.

| | | |
|---|---|---|
| A MECHANICAL·COURSE·FOR·HIGH·SCHOOLS. BY ROBERT A·PERKINS. | | |
| PLATE H | MECHANICAL DRAWING · COURSE D2 · | DRAWN BY R.A.Perkins |

| A MECHANICAL·COURSE·FOR·HIGH·SCHOOLS. BY ROBERT A. PERKINS. | | |
|---|---|---|
| PLATE ·I· | MECHANICAL DRAWING ·COURSE D2· | DRAWN ·BY· R·A·Perkins |

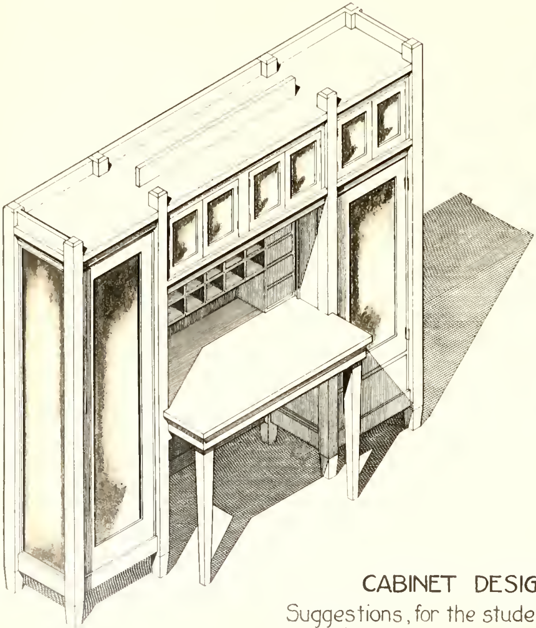


FIG. 1

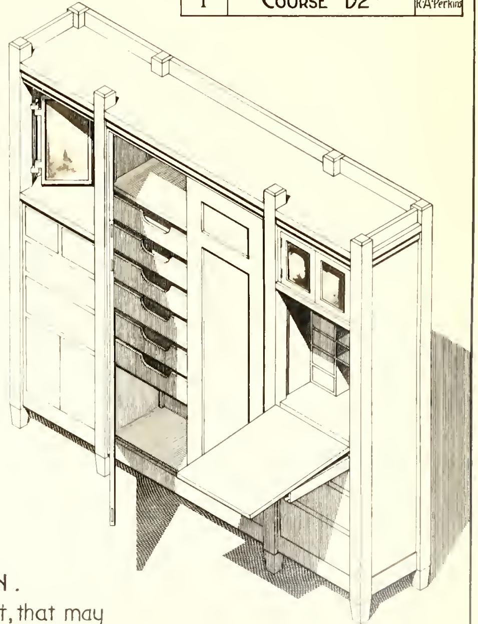


FIG. 2

CABINET DESIGN.

Suggestions, for the student, that may prove helpful in the working out of plate three, course D2. See text for further information.

[illegible]

(Line)

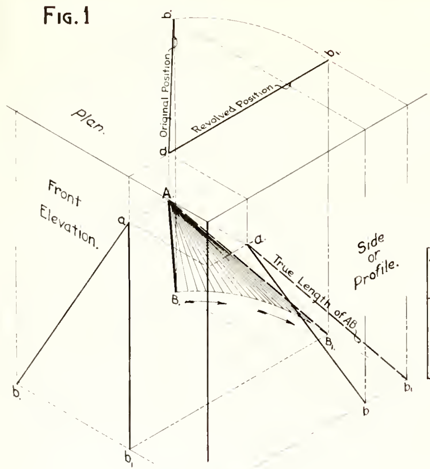
R[illegible] "[illegible]-graphic [illegible] line", it is first [illegible] the "line" and its projections [illegible] positions relative to the planes of projection.

([illegible]:- [illegible], [illegible], [illegible] [illegible].)

[illegible] this [illegible] [illegible]-[illegible], [illegible] [illegible] the ability to [illegible] [illegible].

Figure one, [illegible] shows a line (A-B) [illegible] of projection. (A-B), [illegible] upon each of these planes, [illegible]; i.e. the line (A-B) [illegible] in all three views.

Fig. 1

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FOR HIGH·SCHOOLS.
·BY·
ROBERT A PERKINS.

MECHANICAL DRAWING
COURSE D2
PLATE J

Fig. 3

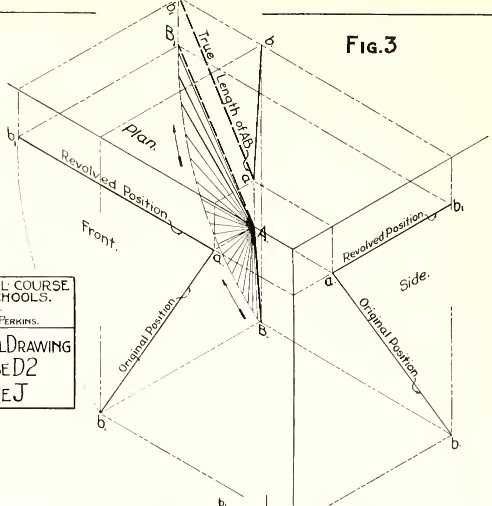



Fig. 2

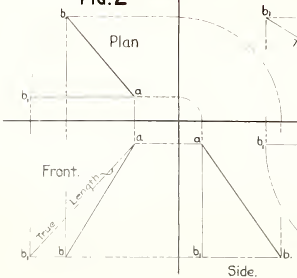



Fig. 4

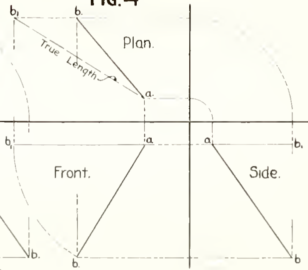
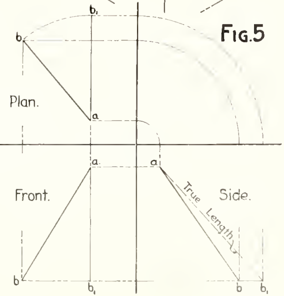



Fig. 5



A Mechanical Course for High Schools.

tion (A-B') will be the required revolution of (A-B), since it is the true-length projection of a line parallel to V.

Figure 5 shows this method in a single plane, i.e. shows the Fig. 1 folded up. (See "Applications", Art. VIII, D.)

Another method, involving the same principles as the first method, but carried out in one plane as the plan view, is illustrated in Fig. [illegible], Plate [illegible].

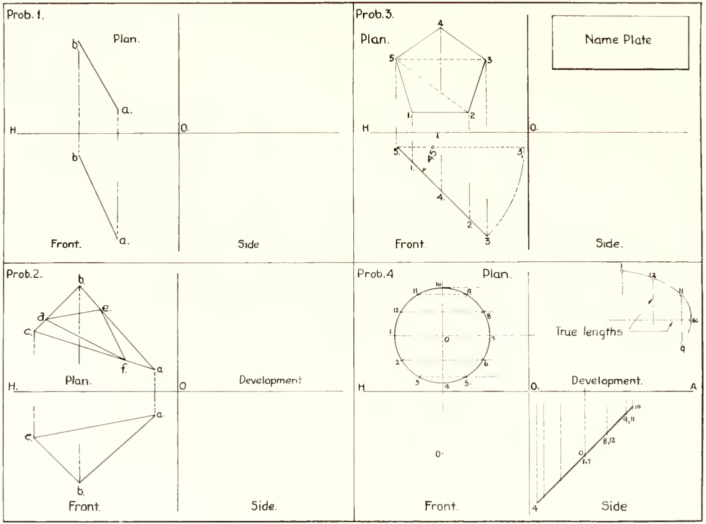
It will be seen that A is again the center of revolution, but B is moved to the new position B', so that its path lies in a plane parallel to the vertical, i.e. perpendicular to H, and that the final position of the line (A-B) is (A-B') which, as is shown, is parallel to V. Also it will be noted that the projection of the path of B, from B to B', which is shown by (B-B'), appears as a line parallel to the [illegible].

A Mech[illegible]

[illegible]

Prob 1
Given:- Pt. O, $5\frac{3}{4}$" R - $3\frac{1}{4}$" D.
Pt. a, $3\frac{3}{4}$ - $3\frac{1}{2}$ + 3/4
Pt. b, $2\frac{1}{2}$ - 3/4 + 3.
Required:- The true length of a-b in plan, front, and side views. a and b will each be taken as the center of revolution, thus obtaining the true length twice in each view.
Note:- In this and all succeeding plates the coordinates of points will be given as follows; 1st distance from left border line, 2nd vertical projection, and 3rd horizontal projection. The + sign will always indicate locations above HO and the - sign points below HO.

Prob. 2.
Given:- Pt O, $5\frac{3}{4}$" R - 12 3/4 D.
Pt a, 5 - 3/4 + 3/4
Pt b, $2\frac{1}{2}$ - 3 + $3\frac{1}{2}$.
Pt c, 1 - $1\frac{1}{2}$ + 2.
Pt d, $\frac{1}{2}$" from c on bc.
Pt. e, 1" from b on ab
Pt. f, 1" from a on ac
Required:- The drawing of triangles a-b-c and d-e-f in plan, front, and side views and the construction of development of the figure.
Note - The explanation given below is for the development of figures whose surfaces are triangles or some geometrical unit capable of subdivision into triangles.

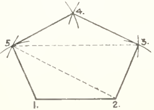



Prob 3
Given:- Pt O, $17\frac{1}{4}$" R - $3\frac{1}{4}$" D.
Pt 1, $13\frac{1}{4}$ - ? + 5/8.
Pt 2, $15\frac{1}{8}$ - ? + 5/8
Pt 5, ? - 1/2 + ?
The plan view of figure is a perfect pentagon the front view being a line inclined 45° to HO
Required - The construction of the side view of figure and also the determining of true area of same, in the plan view, by revolving entire figure into plane parallel to H. Check results with true lengths obtained by use of V and SV projections.

Prob 4.
Given:- Pt. O, $17\frac{1}{4}$ R - $12\frac{3}{4}$" D
Pt o, $14\frac{1}{4}$ - 2 + $1\frac{1}{2}$
The plan view a circle with center at o and side view a line at 45° to AO
Required - Front view and development of figure.
Note - Draw horizontal and vertical diameters and subdivide quadrants into three equal parts. Number points as indicated. Find true length of lines 3-5, 2-6, 1-7, 12-8, and 11-9, also determine perpendicular distances 4 to 3-5, 3-5 to 2-6 etc. These dimensions are coordinates of required true curve.

To develop any geometrical figure, such as is shown in Prob 3, a convenient way to proceed is as follows; draw 2-5 and 3-5 and determine their true lengths as well as those of 1-2, 2-3, etc. Lay off true length of 1-2, as indicated in figure below, and then with points 1 and 2 as centers and with true lengths 2-5 and 1-5 as radii draw arcs intersecting at 5. Now with points 2 and 5 as centers and with true lengths 2-3 and 5-3 as radii draw arcs intersecting at 3. Finally, to determine the location of point 4, take points 3 and 5 as centers and with radii 3-4 and 5-4 draw arcs intersecting at 4. The results obtained by this method should agree exactly with those obtained in any other manner. The student should verify the above statement by checking his results in Prob.3 in this way.

DEVELOPMENT OF PROB 3




NOTE:-
Neat and accurate solution of the four problems stated above constitutes the work required in PLATE 4.

See text for instructions, questions, etc

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|---|---|---|
| PLATE K | MECHANICAL DRAWING · COURSE D2 · | DRAWN BY R.A. Perkins |

[illegible]

4th. [illegible] from V [illegible] [illegible] will be a line [illegible] each of the points. Draw [illegible] length.

5th. [illegible]

6th. Point [illegible]

(Note: [illegible] if exactly [illegible])

Problem [illegible].

[illegible]:—

1st. Draw [illegible] the [illegible] of the problem [illegible] the requirements.

2nd. Construct [illegible] the given plan [illegible].

3rd. Make [illegible]

# PLANES.

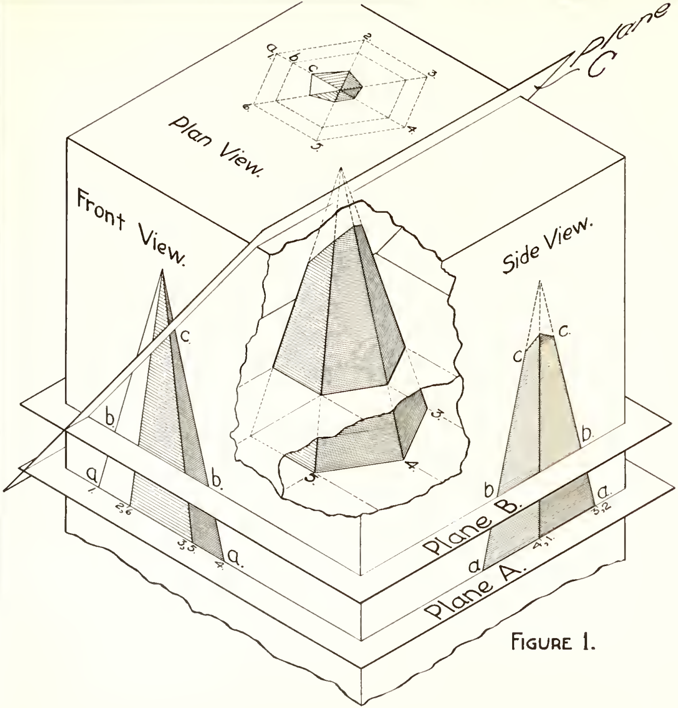


FIGURE 1.

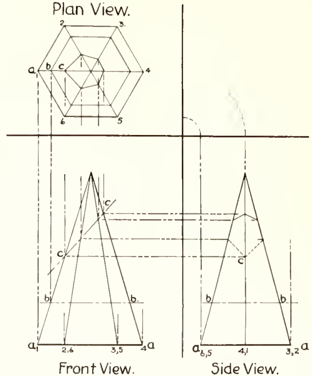


FIGURE 2

NOTE:— For information, instructions, questions, etc. pertaining to this plate see accompanying text.

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|---|---|---|
| PLATE L | MECHANICAL DRAWING COURSE D2. | DRAWN ·BY· R.A.Perkins |

A [illegible].

[illegible], [illegible]

B- A plane, [illegible] cutting planes, [illegible].

C- The angle between [illegible] plane, [illegible].

D- The projection [illegible], [illegible], [illegible].

E- [illegible] of any two [illegible] by any other plane. (Note:- [illegible] plane [illegible] the first [illegible], [illegible], and [illegible].)

No proof of [illegible] will be attempted, as the student will [illegible] have obtained sufficient mathematical training [illegible] that to differ [illegible], if [illegible]. They will be taken [illegible] explained by [illegible] by [illegible] illustrations.

A Mechanical [illegible] for High School.

(1)- [illegible] (1) [illegible] [illegible] (1) [illegible] [illegible] line, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] in [illegible] [illegible] [illegible] in the [illegible] [illegible] [illegible]

(2)- [illegible] [illegible] [illegible] [illegible] to V and SV, [illegible] [illegible] [illegible] [illegible] V-S, [illegible] V, which is [illegible] to [illegible] and SV is [illegible] [illegible]

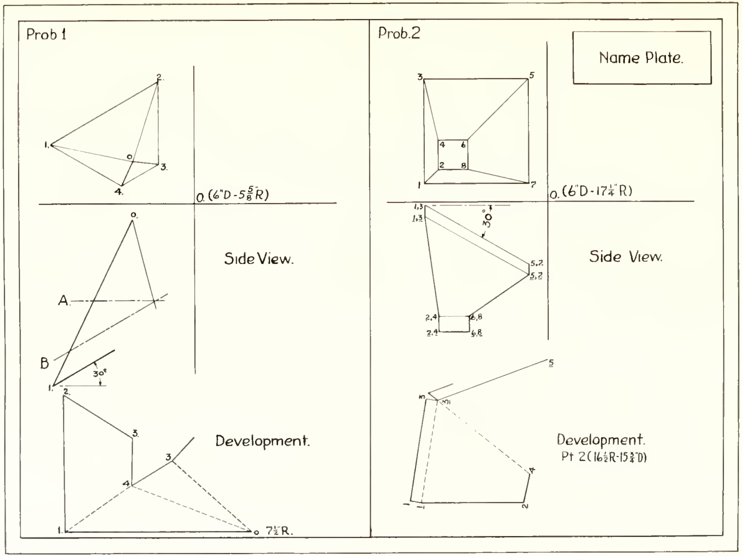
(3)- [illegible] by [illegible] (6), [illegible] [illegible] [illegible] (abc), [illegible] [illegible]

(4) [illegible] and [illegible] [illegible] [illegible] (a) and (b) [illegible] [illegible]

## Problem 1.

Given:— An oblique pyramid with vertex o, $3\frac{3}{4} - \frac{1}{2} + 1\frac{3}{8}$, and with base inclined 30° to H and perpendicular to V as indicated. Pt. 1, $1\frac{1}{8} - 6 + 2$, pt. 2, $4\frac{1}{2} - ? + 4$, pt. 3, $4\frac{1}{2} - ? + 1\frac{1}{4}$, and pt. 4, $3\frac{3}{8} - ? + \frac{1}{2}$, determine lines of the base. The plane B is passed perpendicular to V and parallel to the base, $\frac{1}{2}$" above same, and plane A is passed perpendicular to V and parallel to H cutting 0-3 at the same point as B.

Required:— The plan, front, and side views and development; the trace of both cutting planes to be shown in all views.




## Problem 2.

Given:— The plan and front views of a sheet-metal hopper. The plane 1-3-5-7 is perpendicular to V and inclined 30° to H as indicated. The points necessary to fully determine the figure are pt. 1, $13\frac{1}{4} - \frac{1}{8} + \frac{5}{8}$, pt. 2, $13\frac{3}{4} - 3\frac{3}{4} + 1$, pt. 3, $13\frac{1}{4} - \frac{1}{8} + 4$, and pt. 4, $13\frac{3}{4} - 3\frac{3}{4} + 2$. In the plan view the hopper and throat appear as squares. The planes 2-4-6-8 and $\underline{2}$-$\underline{4}$-$\underline{6}$-$\underline{8}$ are parallel to H and $\frac{1}{2}$" apart. The vertical distance from 1-3-5-7 to the plane of $\underline{1}$-$\underline{3}$-$\underline{5}$-$\underline{7}$ is $\frac{3}{8}$".

Required:— The plan, front, and side views and development of the figure.

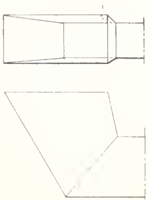


Fig. 1

### Note

Either the elbow connection, shown in Fig. 1, or the ventilator, shown in Fig. 2, may be substituted for the hopper in Prob. 2; the dimensions, location etc. being determined by the pupil.

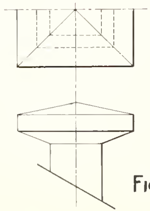


Fig. 2

### Note.

Plate number 5 of course D2 will consist of the correct solution of Probs 1 and 2, or optional Prob 2, as noted.

See Text.

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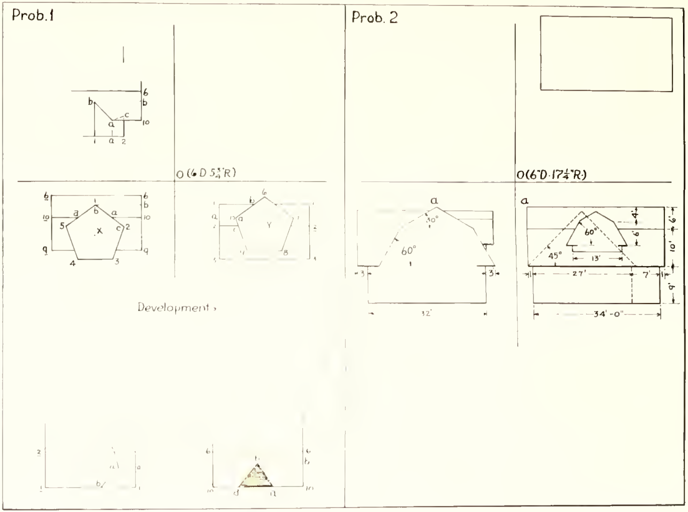
|---|---|---|
| Plate M | Mechanical Drawing. Course D2. | Drawn by R.A.Perkins |

## Problem 1.

GIVEN:-Two right pentagonal prisms of 3" altitude, the bases being inscribed in circles of 2" radius. The axis X-X is perpendicular to V and Y-Y to SV, point X being located $3-1\frac{7}{8}+1\frac{1}{2}$ and point Y, $4\frac{1}{2}-1\frac{1}{2}+3$. The lower face of each prism is to be placed parallel to H.

REQUIRED:- The plan, front, and side views of prisms and development of same showing complete line of penetration. Again lay out developments, after the completion of the plate, upon Bristol board or other heavy paper. Cut and fold these so as to check the accuracy of the drawing.




## Problem 2.

GIVEN:- Front and side views of a residence with gambrel main and dormer roofs and with a gable roof over the rear portion. The various angles of the roof and the dimensions of the residence are shown upon the elevations. Drawings are to be made to a scale of $\frac{1}{8}$"=1'-0". Point a is located at $14\frac{5}{8}-\frac{7}{8}+\frac{3}{8}$.

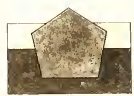
REQUIRED:- The making of drawings showing plan, front, and side views with all valley lines accurately located. Make also a development of each of the roofs in the space below the elevations. As in the previous problem, check results by cutting out, folding, and fitting the various parts of the complete roof development.

Front View.

NOTE

If the student has time, the surfaces should be shaded with flat washes, as here shown, as the appearance of the plate is greatly added to by so doing

Side View.



NOTE.

Plate 6 of course D2 will consist of the accurate solution of the above two problems. See text for instructions, questions, etc.

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|---|---|---|
| PLATE N | MECHANICAL DRAWING · COURSE D2 · | DRAWN ·BY· RAPerkins |

[illegible]

[illegible]

[illegible]

[illegible]:-

1st. [illegible] requirements [illegible].

2nd. Compl[illegible] i.e. [illegible]

3rd. [illegible]

(NOTE:- [illegible] (1-1), (2-2), [illegible] (1-1), (2-2) etc., [illegible] view. [illegible] (3-3), [illegible] (10-10) [illegible] (1-1), (2-2) etc. [illegible])

4th. [illegible]

A Mechanical [illegible].

[illegible]

[illegible]

[illegible]

QUESTIONS:-

I-

[illegible]?

II-

[illegible]?

III-

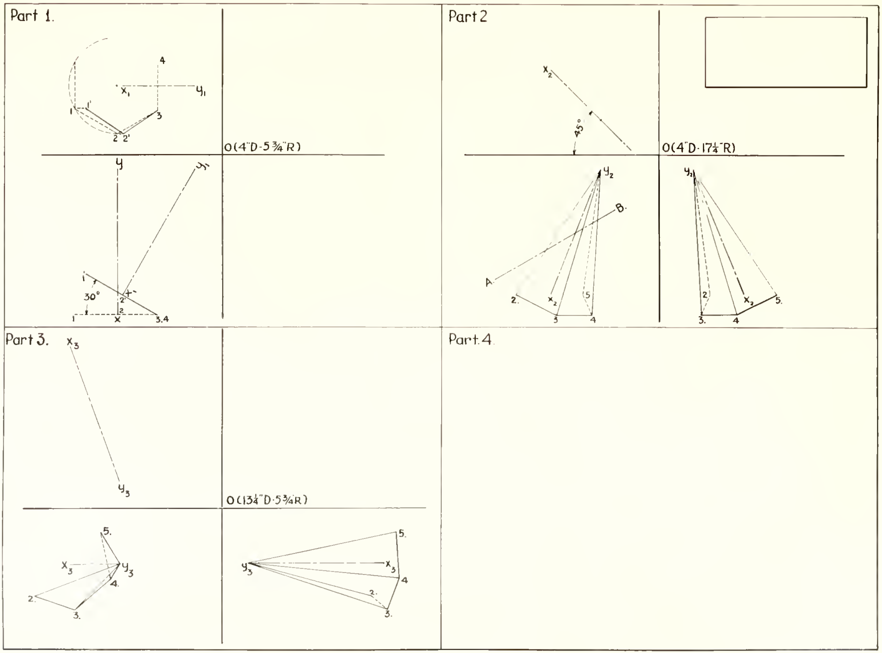
[illegible]?

[illegible]

[illegible]

GIVEN:-

[illegible]




NOTE:— THE · CORRECT · SOLUTION · OF · THE · FOUR · PARTS · OF · THE · ABOVE · PROBLEM · WILL · CONSTITUTE · THE · REQUIRED · WORK · OF · PLATE · SEVEN · COURSE · D2. FOR THE · DATA, COMPLETE · INSTRUCTIONS, QUESTIONS, ETC. FOR · THIS · PLATE · SEE · ACCOMPANYING · TEXT.

| | | |
|---|---|---|
| A MECHANICAL · COURSE FOR · HIGH · SCHOOLS<br>BY ROBERT A · PERKINS. | | |
| PLATE<br>O | MECHANICAL DRAWING<br>· COURSE D2 · | DRAWN<br>· BY ·<br>RAPerkins |

# [illegible]

[illegible]

PROBLEM:-

[illegible]

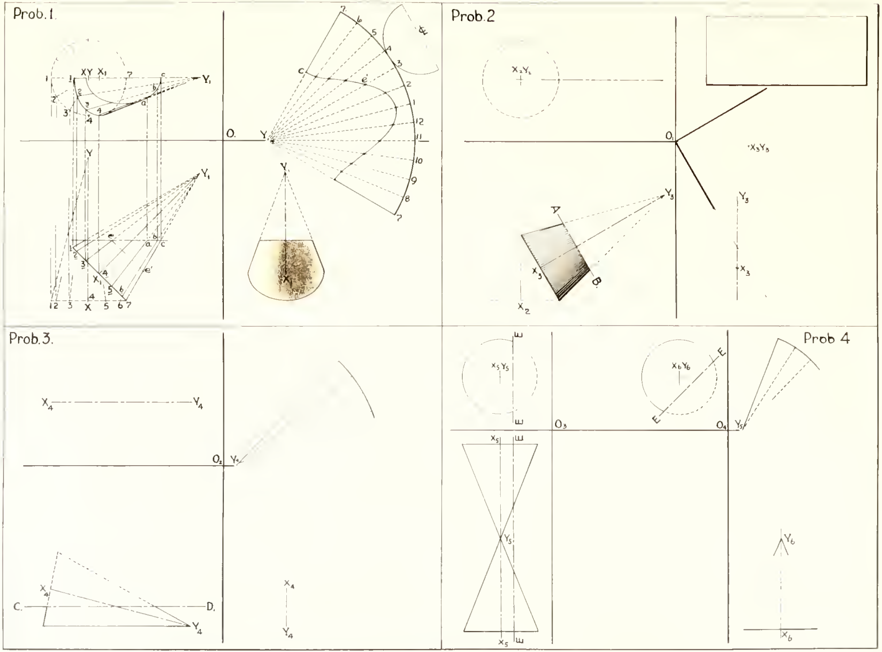
PURPOSE:-

[illegible] spherical position.

INSTRUCTIONS:-

1st. [illegible]

[illegible]




NOTE:— PLATE · NUMBER · EIGHT · OF · COURSE · D2 · WILL · CONSIST · OF · THE · WORKING · OUT · OF · THE · FOUR · PROBLEMS · IN · CONIC · SECTIONS · ABOVE · OUTLINED. FOR · DATA; INSTRUCTIONS; QUESTIONS; ETC. · SEE · TEXT · ACCOMPANYING. · SHADE · IF · TIME · PERMITS.

| | | |
|---|---|---|
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| PLATE P | MECHANICAL DRAWING · COURSE D2 · | DRAWN BY R.A.Perkins |

[illegible]

[illegible]

[illegible]:-

[illegible]

[illegible]:-

The student should [illegible] this [illegible]

[illegible]:-

In [illegible]?

[illegible]

[illegible]:-

[illegible]

These [illegible]

([illegible] 1, [illegible])

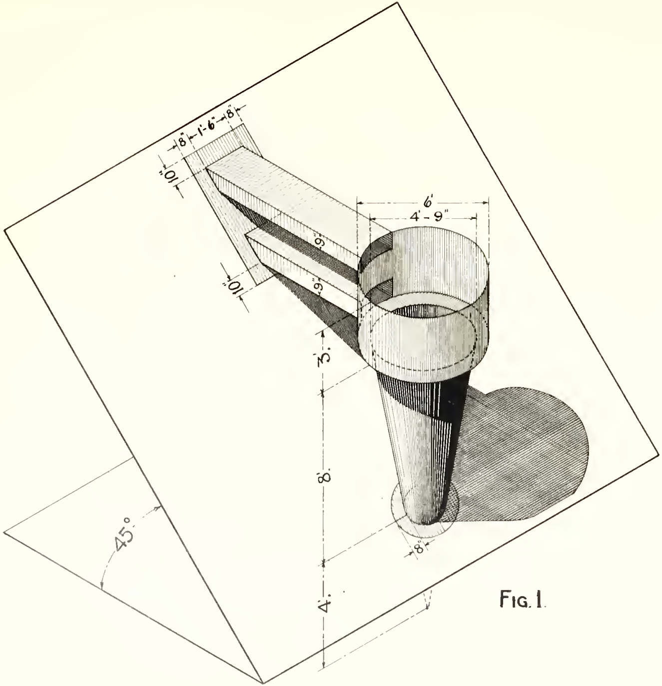
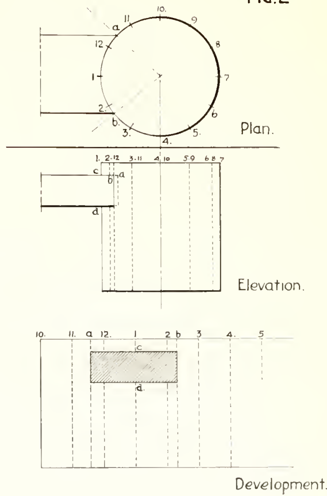



Fig. 1.

Fig. 2




Note:- The making of working drawings of apparatus shown in Fig 1 will constitute the requirements of Plate 9, course D2. See text for complete instructions.

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| PLATE<br>Q | MECHANICAL DRAWING<br>· COURSE D2 · | DRAWN<br>BY<br>RA Perkins |

A MECHANICAL COURSE FOR HIGH SCHOOLS.

BOOK IV.

TABLE OF CONTENTS OF BOOK IV.

COURSE S1.

# LIST OF ILLUSTRATIONS
of
COURSE 51.

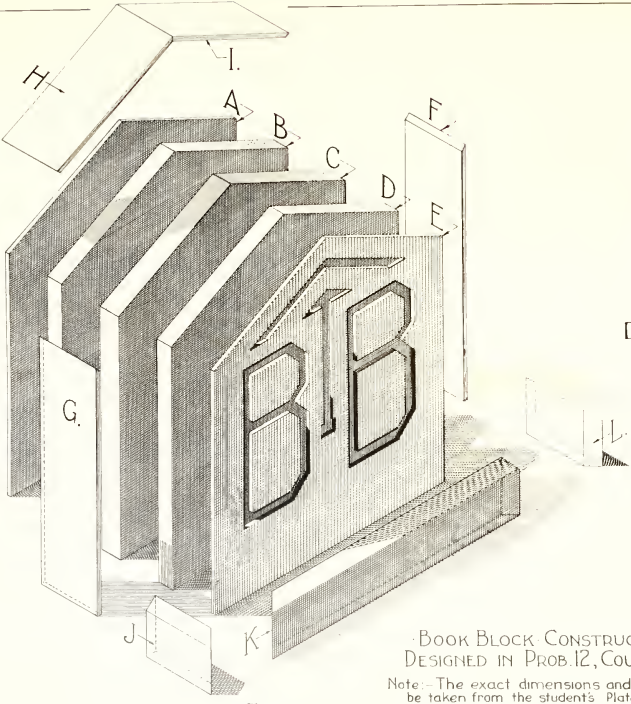


Fig. 1.

# Explanation ·of· Drawing.

A and E :– Veneer of front and back face. Original design to be cut from front face before gluing.
B and D :– Soft wood sections with vertical grain.
C :– Soft wood section with horizontal grain.
F and G :– Veneer of sides May be left plain, as here indicated, or contain a panel or design, as suggested in the shop sketch of Prob. 12, D1.
H and I :– Top veneer.
J, K, and L :– Front and side pieces of base. Made of the same hard wood as veneer.
Note :– For shop instructions see accompanying text.

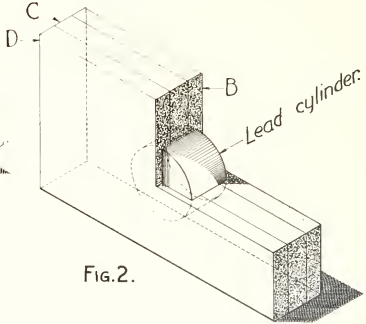


Fig. 2.

·Book Block·Construction·
Designed in Prob. 12, Course·D1.

Note:– The exact dimensions and design will be taken from the student's Plate 6, Course D1. The face will be designed with as much originality as possible, the ideas suggested in this plate and in Plate H, D1 showing about what is required.

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|---|---|---|
| Plate A. | Wood·Working. ·Course S1· | Drawn ·By· R.A. Perkins |

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WOOD WORKING.

Course S1.

As previously explained, not less than one hundred and eight hours of shop work are required in the seventh and eighth grades as a prerequisite to the course here presented; this time to have been spent in a carefully supervised study of the construction, care and method of using the more important wood working tools; in learning to distinguish the characteristics of various woods; and in exercises in joinery requiring the use of both mechanical and glued joints. Without arranging for the above preliminary instruction, this course should not be attempted.

Assuming then that the student has received the necessary training in the foregoing important introductory details, we will proceed at once to an explanation of the problems of

the course. These explanations will be given in the same order as the working drawings appear in Course D1, the pupil selecting from them the three that he designed for his course in Shop S1.

Plate A- Course S1.

In Plate A of Course S1 will be found the details for the construction of the Book Block designed in D1, Prob. 12. The following outline will be found helpful in its construction.

First:-

Construct the parts B,C, and D of clear white pine or white wood, remembering that the grain of B and D is to run vertically and that of C horizontally. Why?

(a) To find the dimensions of the pieces, substitute in the following equations.

Let T equal thickness of block taken from design of Prob. 12,
t equal thickness of veneer, and
t' equal thickness of each of the pieces of B,C, and D.

Then t' equals $\frac{T-2t.}{3}$ Why?

Let W equal width of the block taken from the design of Prob. 12, and

W' equal width of B,C, and D.
Then W' equals W-2t. Why?

Let H equal total height of block from base to vertex as taken from design of Prob. 12, and let

H' equal height of B,C, and D to their vertices.

Then H' equals H-t (if upper end of the block is square) and H' equals H- 2t (if the angle included between the upper faces is ninety degrees.) Why?

To determine the amount to be subtracted from H, for angles between these two values, use a graphical method with a scale several times full size, i.e. draw two lines, inclined at the proper angle, a distance apart equal to the thickness of the veneer, to the chosen scale, and measure the distance cut by these lines from any vertical line. This distance reduced to full size will be the required amount to subtract from H.

(NOTE:- In using formulas, all dimensions must be reduced to the same unit. Why?)

(b) Make each piece a true rectangle of dimensions H'xW' and of thickness t'.

(NOTE: - USE A SHARP KNIFE AND SQUARE FOR LAYING OUT ALL LINES ACROSS THE GRAIN OF THE WOOD. Use a guage for lines with the grain. Leave the trace of these just showing on the finished pieces. Be sure that the surfaces of B,C, and D are plane surfaces, i.e. that when placed in any position, one upon another, a pressure exerted at the corners will produce no rocking motion.)

(c) Draw the vertical center line of each piece and, with a bevel, lay off in each case the angle of the top faces from the point at which the upper edge is crossed by this line. Finish the top edges.

(d) Make lead weight by filling a short section of light brass tubing with molten lead. Make the length of each weight 2t'.

(e) Locate a point on each center line a distance from the base equal to 1 1/2 times the diameter of the lead weight. With this as a center and, with an expansion bit set to the diameter of the weight, bore a hole completely through one piece and half way through each of the other two pieces. (See Fig. 2.)

Second:-

Glue together the pieces B,C, and D, having first inserted the lead cylinder as indicated in Fig. 2.

CAUTION: Clamp securely so that no slipping of the sections out of alignment will be possible. Use only the best of hot glue.

Third:-

Make the faces A and E with the grain of the veneer running vertically in each case.

(a) As in the case of the parts B,C, and D, first make A and E perfect rectangles of dimensions W'xH'.

(b) Draw center lines and lay off the angles of the top faces as before.

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(c) Cut original design from front face, E as indicated in Fig. 1.

CAUTION: Keep the veneering firmly clamped between other heavier pieces, while performing the various operations to prevent its splitting. See that every tool employed is as sharp as it can be made.

Fourth:-

Glue A and E to the block formed of B, C, and D. Observe "Caution" of the second step.

Fifth:-

F and G will next be made. These side pieces also will have their grain extending vertically.

(a) First construct two rectangular pieces of veneer of width [illegible] and approximately one inch longer than the side of the block.

(b) At a distance from either end of block, equal to that of point E from the base, draw a line squarely across the inner face of each piece.

(c) Bisect the angle between either top face of the block and the vertical side adjoining it. Set the bevel to this angle and transfer it to the edges of F and G, i.e. let the head of the bevel rest against the outer faces and the edge of the blade pass through the ends of the lines drawn in step (b) while making the lines across the edges.

(d) Square across the outer faces of F. and G, through the upper points of the angles just transferred.

(e) Finish these upper edges exactly to line.

Sixth:-

Glue F and G in position. Observe "Caution."

Seventh:-

Make upper faces H and I with grain of veneer extending in the direction of the longest dimension.

(a) Construct two rectangular pieces of veneer of width T and approximately one inch longer than the distance from the vertex to the point E, i.e. one inch longer than either of the upper faces.

(b) Bevel one end of each piece to the same angle as that at the upper ends of F and G.

(c) At a distance from the inner edge of each of these bevels, equal to that from point E to the vertex of the block, draw a line squarely across the lower face of each piece.

(d) Bisect the angle included between the upper faces of the block. Transfer this angle to the edges of the pieces H and I, i.e. let the head of the bevel, which has been set to the

proper angle, rest against the upper faces of the parts H and I and let the edge of the blade pass through the ends of the lines drawn in step (c) while making the lines across the edges.

(e) Square across the upper faces of H and I through the outer points of the angles just transferred.

(f) Finish these ends exactly to line.

Eighth:-

Glue H and I in place. Observe "Caution."

Ninth:-

Make strip of base molding of ample length for the front and two sides of block as indicated at J,K and L. This will, of course, be made of the same kind of hard wood as the veneer.

(a) Square one end of the strip of molding and, at a distance T, draw a line squarely across the inner face of the molding. Cut a forty-five degree mitre through this line. See J of Fig. 1.

(b) In the same manner lay off the pieces K and L, making the inner face of K equal to J and that of L equal to T. See K and L, Fig. 1 for directions in which mitre is to be cut.

Tenth:-

Glue J,K and L securely in place. Observe "Caution."

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Eleventh:-

Sand paper the surfaces, using only fine paper, secured to a sand paper block. Be careful to round none of the edges. Do not sand across the grain of the wood.

Twelfth:-

Stain, fill and wax or shellac.

Thirteenth:-

Cut a piece of heavy felt to the exact size of the base of block and secure in place with cold glue.

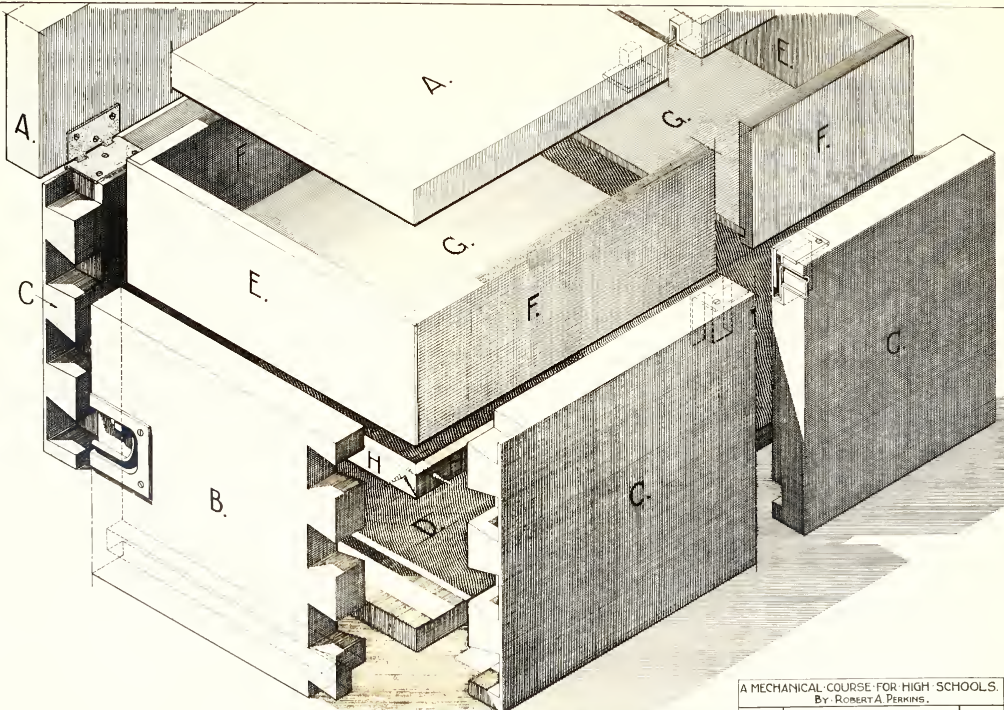
NOTE: The two blocks of the set may be carried along in consecutive steps or may be completed separately as preferred.

Plate B of Course S1.

Plate B of Course S1 gives the details of construction of the tool chest designed in Prob. 13, D1. The parts, whose construction will herein be explained, are:

A.- Box cover, showing position of hinges and lock.

B.- End of box showing position of handle, dovetails, and rabbet to receive the bottom (D).

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|---|---|---|
| PLATE B. | WOOD WORKING. · COURSE S1 · | DRAWN · BY · R.A.Perkins. |

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C.- Front of box, showing lock, dovetail with blinds, and rabbet to receive the bottom D.

D.- Bottom of chest.

E.- End of tray showing corner construction.

F.- Side of tray showing corner construction and method of holding the bottom of tray, G.

G.- Bottom of tray.

H.- Strip secured to ends, and sides of chest to support the tray and to allow it to be moved from the front to the back of the box.

In building the chest the following steps will be taken.

First:-

Construct the sides and ends of the box of hard or soft wood, as directed by the supervisor.

See NOTE of step (b) of preceding problem.

(a) Let L equal total length of box taken from student's design of Prob. 15, D1,
W equal width of box,
D equal depth of sides of box, exclusive of cover,
T equal thickness of sides and ends of box, and
t equal thickness of blind.
Then L' equals the length of the end pieces (B) equals W-2t. Why?

Let t' equal thickness of bottom of chest. Then depth of rabbet equals 3t'/4 and bottom of box is set up a distance equal to t'. By substitution determine the above dimensions.

(NOTE:- In using formulas, all dimensions must be reduced to the same unit. Why?)

(b) Make two rectangular pieces of dimensions LxD and thickness T and two of dimensions (W-2t)xD and thickness T. The grain of each piece is to run in the direction of its long dimension. Finish to these dimensions.

(c) The rabbet, to receive the bottom, will next be cut in these pieces. This is to be of width t', of depth 3t'/4, and is to be parallel to the lower edge and a distance t' above it. This may be made with a plow, may be cut with a dado saw, or may be cut out with a chisel, exactly as would be done in driving a mortise for a mortise and tenon joint.

(d) Lay out dovetails on end pieces B. These will be (T-t) in length and of width and taper indicated in the student's design. Saw just outside the lines running with the grain and chisel just outside those running across it. Finish exactly to the line with an extremely sharp chisel of a width as great as can be conveniently used.

(e) Lay out dovetails upon the ends of the sides (C). Check with those cut from B to be sure that no error has been made. Saw along the

lines extending in the direction of the grain, being careful, however, to hold the saw inclined at such an angle as to keep it from touching the blind. It will, of course, only be possible to cut the corners in this manner, but this will be found a great help when it comes to removing the remainder of the material with the chisel.

(f) Carefully fit each corner joint and assemble the sides and ends without gluing.

Second:-

Make the bottom of the box of hard or soft wood, as directed by the supervisor. The grain of this piece, D in the figure, is to extend in the direction of its long dimension. If the design calls for a large box, this may be glued up of two or more pieces.

(a) This piece will be of rectangular shape, its length being L-2(T-3t'/4), (Why?) and its width W-2(T-3t'/4), (Why?) Its thickness will be t'. Finish to these dimensions.

Third:-

Make the strips (H) of dimensions indicated in the design of Prob. 15, D1. Oak or birch to be used with holes drilled for screws and counter-sunk for heads.

(a) Make two of these pieces of a length equal to the width of the inside of box, i.e. W-2T. Cut ends at forty-five degrees mitre as indicated.

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(b) Make two of these pieces of a length equal to that of the inside of the box, i.e. L-2T. Cut ends at a forty-five degree mitre, as indicated.

(c) Secure these strips to the sides and ends of the box with screws and glue. The distance from the upper edge to each of the pieces (B) and (C) should be equal to the width of (E), which we will call (w).

Fourth:-

Glue the corner joints, first inserting the bottom in the rabbet provided for it. Do not glue the bottom into the rabbets. Why? Use hot glue only.

Fifth:-

Construct the sides (F) and the ends (E) of the tray. These are to be made of hard or soft wood, as directed by the supervisor, with the grain running in the direction of the long dimension of the piece in each case.

(a) Make joint at corner, as indicated, and make rabbet for bottom exactly as was done for the bottom of main chest. The width of each piece will be (w), the length of (E) will be the dimension given on the student's design, and the length of (F) will be L-2(T+t") where t" is the thickness of the blind of the corner joint. Why?

Sixth:-

Make bottom for tray exactly as was done in the case of the bottom of the chest, keeping in mind the changed proportions.

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Seventh:-

Glue the corners, first inserting the bottom in the rabbet provided for it. Do not glue the bottom. Why? Use hot glue.

Eighth:-

Make cover (A) of the same material as (B) and (C). The grain of this piece is to extend in the same direction as the long dimension of the box.

(a) The cover will be glued up of two or more pieces, depending upon the size of the box shown in the student's design, and will be finished a perfect rectangle of length L, width W, and of thickness indicated in the drawing.

Ninth:-

Place the two end hinges as indicated. A third hinge may be located exactly in the center of the cover if the design calls for a large box.

(a) These hinges are to be mortised so that the faces will be flush with the surface of the cover and the upper surface of the side of chest. Great care must be exercised to set hinges in exact alignment with each other and with the box. First secure the hinges in their correct position upon the box.

(b) After this has been done, close the hinges, place the cover in its position, and mark with knife blade the exact location of the hinges at the back edge of the cover.

(c) Upon the inner face of the cover, square in from these points and cut mortise of correct depth and width.

(d) Screw hinges in position.

Tenth:-

Mortise lock in front (C) and in the cover (A) as indicated.

Eleventh:-

Mortise for handles slightly above the horizontal center line and exactly upon the vertical center line of the ends (B).

Twelfth:-

Sand paper all surfaces, using a sand paper block at all times. Do not round edges. Do not sand across the grain of the wood.

Thirteenth:-

Stain inside and outside. Fill and shellac or wax outside surfaces only.

Fourteenth:-

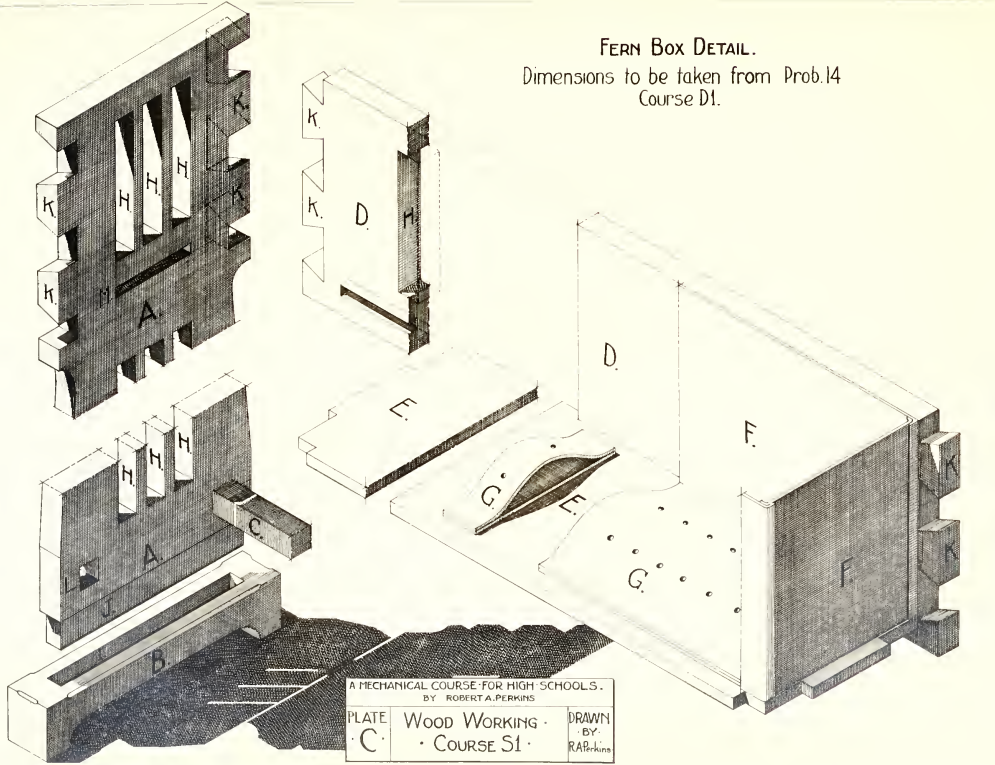
Screw handles in place.

Plate C of Course S1.

The next problem to be considered is that shown in Plate C of Course S1, which contains

## Fern Box Detail.

Dimensions to be taken from Prob. 14
Course D1.

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| PLATE · C · | WOOD WORKING · · COURSE S1 · | DRAWN · BY · R.A.Perkins |

the details of construction of the fern box, designed in Prob. 14, D1. The parts shown, whose construction will later be explained, are:-

A.- End of box and vertical support or standard.

B.- Base block.

C.- Cross braces.

D.- Sides of box.

E.- Bottom of box.

F.- Sheet zinc earth retainer.

G.- False bottom to allow excess water to drain.

H.- Vertical openings of rectangular shape to lighten the appearance of the parts.

I and J.- Mortise and tenon securing end to base block.

K.- Dovetail joints.

L.- Mortise to receive cross braces.

M.- Rabbet to receive bottom of box.

The outline of the steps to be taken in constructing the fern box is as follows:

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First:-

Make the two side pieces (D) of hard or soft wood, as directed by the instructor, with the grain running in the direction of their length.

(a) Let L equal total length of box, taken from student's design,

W equal width of side,

T equal thickness of side, and

t equal thickness of bottom.

Then depth of rabbet equals 3t/4.

Distance of rabbet from the bottom edge of side equals t.

Length of rabbet equals L-4(T)

Length of dovetails equal T.

By substitution, determine the above dimensions.

(b) Make two rectangular pieces of length L, width W, and thickness T.

(c) Plow, saw or chisel rabbet at the lower edge of each piece, making its width t, depth 3t/4, and its distance from the edge t. Its length will be L-4T and will be centrally spaced.

(d) Lay out and cut dovetails at ends as designed in Prob. 14, II.

(e) Cut openings (H) according to design. Lay out carefully upon both inner and outer faces of the side, using guage, knife and square. With brace and bit, bore hole at upper and lower ends of the portion to be cut away.

Saw well inside the lines, removing the material between the two holes. Bring exactly to the line by use of sharp chisel, working from both inner and outer faces.

Second:-

Make two end standards (A) of same material.

(a) Let H equal total height of ends, including base, taken from the student's drawing,

h equal height of base block,
l equal length of tenon,
w' equal width of end at top, and
W" equal width of end at bottom.
Then L' equals H-h+l where L' equals length of end standards (A).
Thickness of tenon equals T-1/4"
Length of tenon equals W"-1/2"
By substitution determine the above dimensions.

(b) Make two rectangular pieces of length L', width W", and thickness T.

(c) Lay out and form the tenons (J) of thickness (T-1/4") and length (W"-1/2") symmetrically located with respect to the axes of the main piece. It is always well to have the surface separating any piece from its tenon slightly dished toward the tenon. This will insure the pieces resting squarely upon the one to which it is attached and will provide a small space for glue when pieces are tightly clamped together.

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(d) Lay out upon both surfaces of the parts (A), the openings (H), rabbets (M) and mortises (L). It is more convenient to do this drawing before the end supports are cut to the form of the design.

(e) Cut the end pieces (A) to form indicated in student's design and lay out and cut dovetails as explained in first step, part (d) of the preceding problem.

(f) Complete operations laid out in step (d). Work to the line from both sides of the pieces in finishing.

Third:-

Make base blocks (B) of same material as other completed parts.

(a) First make two rectangular prisms of dimensions, indicated in design of Prob. 14, D1.

(b) Lay out upon the upper and lower faces of these pieces, symmetrically placed, rectangles of width (T-1/4") and length (W-1/2"). Remove the material within these by chiseling from both surfaces.

(c) Lay out curve of portion to be removed from lower surfaces. Saw this out and finish to line.

(d) Chamfer edges as indicated.

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Fourth:-

Glue base blocks to end standards.

Fifth:-

Make cross braces (C).

Sixth:-

Make bottom (E) of white pine or bass wood.

(a) First make rectangular piece of length L-2(T-3t/4) and width W'-2(T-3t/4).

(b) Cut corners as indicated.

Seventh:-

Assemble and glue parts together.

Eighth:-

Sand and finish as in preceding exercises. Do not round corners and do not sand across grain.

Ninth:-

Have "retainer" constructed by students of Course S9. In case this course is not yet in effect, it will, probably, be necessary for the pupil to have this constructed by an outside mechanic, although the pupil should make the exact patterns to which the sheet metal is to be cut.

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Tenth:-

Paint outside surface of tank so that portions showing through openings (H) will present a neat appearance.

Plate D, Course S1.

In Plate D, the details of the tabourette designed in Prob. 15, D1, are shown, together with an explanation of the letters of reference.

In its construction the following outline will be observed:

First:-

Make upper cross braces (C) of hard or soft wood as directed.

(a) Let W equal distance across faces of square, from which top is made,

W' equal distance across top from face to face, formed by cutting corners of square to receive legs of tabourette,

T equal thickness of legs, braces, and top,

w equal width of braces, and

L equal length of upper braces over all.

Then $\frac{L-W'+3/8"}{2}$ equals distance from each end of upper brace to upper edge of shoulder.

Let t equal thickness of key

Then width of tenon equals 3t.

Obtain values of above terms by substitution.

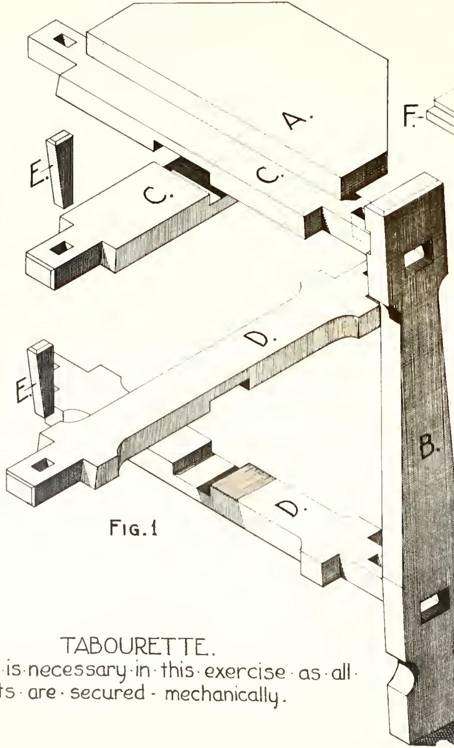


FIG. 1

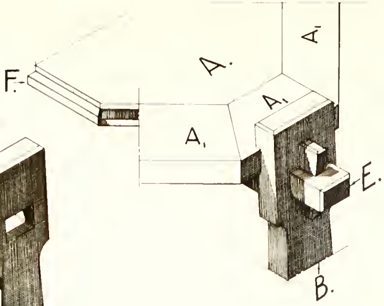


FIG. 2

EXPLANATION.

A.-Tabourette top. May have border pieces
A, if desired.
B.- Leg design.
C.- Upper cross braces.
D.- Lower cross braces.
E.- Keys for holding legs to braces.
F.- Keys for holding border to main part of top.

TABOURETTE.

No glue·is·necessary·in·this·exercise·as·all·the·joints·are·secured·mechanically.

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| PLATE D. | WOOD WORKING · · COURSE S1 · | DRAWN ·BY· R.A.Perkins |

(b) Make two pieces of length L, width w, and thickness T with grain run ing longitudinally.

(c) Assuming 3/16" as depth of dado, lay out tenons on upper surface of each piece, making length $\frac{L-w'+3/8"}{2}$, and width 3t. Set bevel at angle of slope of legs, as taken from design of Prob. 15, D1. Lay this angle off upon each edge, so that the length of the tenons will be slightly less at the bottom than at the top of each piece. Saw out and finish tennons.

(d) Make half-lap joint, so that the two pieces will be at right angles, will have their upper and lower surfaces flush each with the other, and each will have its center line bisected by that of the other.

(e) Chamfer ends of tenons as indicated.

Second:-

Construct lower braces (D) of same material as (C).

(a) Let D equal distance between the upper faces of the two sets of braces as taken from design and,

p equal pitch or slope of legs.

Then length of lower braces equals L+2Dp-3/8". Why?

(b) Make two pieces of length L+2Dp-3/8", width w, and thickness T with grain running longitudinally.

(c) Lay out and construct tenons exactly as was done in the case of the upper braces.

(d) Lay out curves, reducing the width of braces as indicated, and finish to these lines.

(e) Make half-lap joint as in the case of the upper braces, keeping in mind, however, the decreased width of the members.

(f) Chamfer ends of tenons as indicated.

Third:-

Make the four legs (B) of same material as (C) and (D), with the grain running longitudinally.

(a) Construct four rectangular pieces of width w, thickness T, and length, approximately, one inch longer than the legs are shown in the design of Prob. 15, D1.

(b) Set bevel to angle included between upper face of brace and any of the inclined cuts. Transfer this angle to the upper end of each of the pieces (B), laying it out along the edge, so that the angle will be included between the outer and upper faces after cutting to the line.

(c) Transfer this angle to each of the lower ends so that the angle will be included between the inner and lower faces after cutting to the line. The upper and lower faces should now be parallel and the distance between them equal to the length of leg called for in the design of Prob. 15, D1.

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(d) Chamfer upper ends as indicated.

(e) Lay out upper and lower mortises, locating same as indicated in design. The vertical distance between corresponding surfaces of these mortises will be D, their length 3t, and their width T. These mortises must be carefully drawn upon both the outer and inner faces of the legs. To do this, first locate openings centrally upon the outer faces; next, square across these outer faces at the levels of the upper and lower lines of each opening; then, with bevel carry these lines across the edges of the legs, parallel to the lines of upper and lower ends; finally, carrying them squarely across inner faces and locate vertical lines of width opposite those upon the front surface. In driving mortises, work from both faces of legs.

(f) Cut legs to form shown in student's design.

(g) Cut dado across upper end of each leg to receive top. The bottom surface of this will be flush with upper surface of mortise. Its upper surface will be a distance T above this and parallel to it. The depth will be 3/16" at top. Will its depth be more or less at the bottom edge?

Fourth:-

Assemble, temporarily, the braces and legs.

Fifth:-

Make keys of thickness t and of length and taper shown in design.

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Sixth:-

Lay out key-ways.

(a) Hold key against side of each tenon and against outer surface of leg in the vertical posi- that it will occupy in the key-way, i.e. place it with its transverse center line along the longitudinal center line of the edge of tenon. Make line along its outer edge upon side of tenon. Also make line along face of leg upon all faces of tennons.

(b) Square across upper and lower faces of tenon through the upper and lower ends of the line drawn along the edge with the key as a guide.

(c) Remove legs from braces. With guage draw line parallel to each of the edges of tenons and a distance t from them. These lines meet those drawn across the upper and lower faces and form a small rectangle upon each; that upon the lower face being the shorter.

(d) Remove the material from these by chiseling from both upper and lower surfaces.

Seventh:-

Make top of a single piece or of central piece with border as indicated in Fig. 2.

(a) In case top is made of one piece, first make square with sides W and thickness T. Draw diagonals. From their point of intersection, lay off a distance W'/2 upon the diagonals and construct perpendiculars to them at the points thus determined. Cut corners to these lines.

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(b) In case border is used, follow construction shown in Fig. 2.

Eighth:-

Sand paper each part. Use block so that edges will not be rounded. Do not sand across grain.

Ninth:-

Stain and fill all parts.

Tenth:-

Assemble the tabourette.

Eleventh:-

Shellac or wax as preferred.

Plate E of Course S1.

The drafting table designed in Prob. 16, D1, is next shown in detail. This will be found in Plate E, the parts to be explained are:-

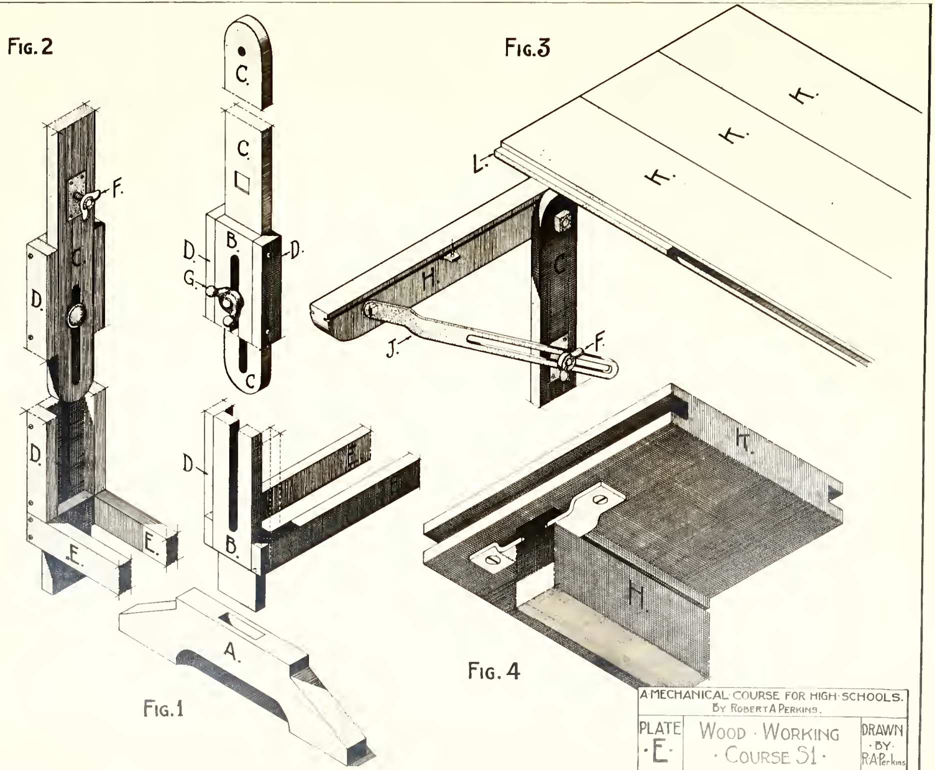
A.- Base block (Fig.1)

B.- Vertical support (Figs. 1 and 2.)

C.- Sliding member of vertical support (Figs. 1,2, and 3.)

D.- Side guides (Figs. 1 and 2.)

E.- Cross braces (Figs. 1 and 2 )

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| | | |
|---|---|---|
| PLATE ·E· | Wood · Working · Course 51 · | DRAWN ·BY· R.A.Perkins |

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F.- Lock nut for holding adjustment of inclination of table top. (Figs 1 and 5.)

G.- Lock nut for holding vertical adjustment of table top. (Figs. 1 and 2.)

H.- Cross pieces of top. (Figs. 3 and 4.)

J.- Adjustment rod. (Fig. 3.)

K.- Sections of table top. (Figs. 3 and 4.)

L.- Strips holding the sections K. (Fig. 3)

All wooden parts with the exception of the top pieces K are to be made of clear red oak, white oak or birch. The top will be made of clear white pine.

First:-

Make the two base blocks (A) with the grain of the wood running horizontally.

(a) Let H equal height of vertical supports including base blocks,
h equal width of cross braces (E),
h' equal height of base blocks,
l equal length of tenons,
T equal thickness of base blocks, and
L equal length of base blocks,
Then length of pieces B equals H-h+l and thickness of tenon equals T-3/4".
Let w equal width of B
Then width of tenon equals w-1/4"
Determine these dimensions by substitution.

(b) Construct a rectangular prism of length L, thickness T and width h'.

(c) Lay out, in a central position, upon both the upper and lower faces, a rectangle of length w-1/4" and width T-3/4". Chisel mortise of this size through the block, driving it from both faces.

(d) Shape ends and cut out bottom portions according to student's design in Plate 16, D1.

Second:-

Construct vertical standards (B) with grain running vertically.

(a) Make two rectangular pieces of length L, width w and thickness T.

(b) Construct tenon of length l, width w-1/4" and thickness T-3/4", centrally located at the lower end of the piece B.

(c) Lay out the distance h, i.e. the height of braces (E) from the base line of vertical supports, as indicated in Fig. 1, Plate E. Square along the edges and across the inner face at this level. Guage a line, a distance T/2 from either the front or back face, along both edges and across the top. Cut out the portion within these lines at the back of each piece as indicated. Finish accurately to the line.

(d) Make vertical slot. To do this, lay out with guage and square on both inner and

outer surfaces. Bore hole at top and bottom ends and saw out material between. Finish exactly to line on both faces.

Third:-

Make side guides (D).

(a) These will simply be rectangular pieces of length H-(h+h'), width T and thickness T/2.

(b) Drill for screws and counter-sink for screw heads.

Fourth:-

Make cross-braces (E).

(a) These will also be rectangular pieces of length indicated upon design of student's plate 16, D1, width h, and thickness T/2.

(b) Drill for screws and counter-sink for heads.

Fifth:-

Make the sliding members (C).

(a) These will be of length indicated in design, of width w, and thickness T/2. The ends will be semi-circular and will be drilled to receive bolt holding top. The lower portion will be slotted, as shown, to allow of greater adjustment than would otherwise be possible.

(b) Attach the lock bolt and plate as indicated. This consists of a square-headed bolt which is mortised in from the outer face of C.

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A plate, drilled and counter-sunk for four screws, is drilled and tapped to screw on over this bolt. The screws are then inserted at the corners, thus holding the bolt firmly in place. These pieces are to be made in the metal working shops, together with the pieces (J) and (G), and the clips holding the top sections to cross pieces (H).

Sixth:-

Make the cross pieces (H).

These will be the dimensions shown in student's design. The groove for holding ends of clips, as indicated in Figs. 3 and 4, are kerfs of a circular saw.

Seventh:-

Make top. This will be of dimensions indicated in student's design and will be glued up of several sections (k) as shown in Figs. 3 and 4. The rabbets for receiving the strips (L) may be made with dado saw or plow. Plane, scrape, and sand the top to a smooth and even surface.

Eighth:-

Assemble the various parts, first carefully sanding each piece as in previous exercises. Do not round corners or edges. Do not sand across grain.

Ninth:-

Scrape off any excess glue and then stain, fill and varnish or wax all hard wood parts. Shellac the top without staining.

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Plate F of Course S1.

The next problem of the series is that of the screen designed in Prob. 17, D1. This is to be constructed of red oak, white oak, or birch. The features shown in detail are:

A.- Ornamental shelf.

B.- Upper rail, showing tenons and manner in which it is cut to receive bracket and shelf.

C.- Bottom rail, showing tenons and mortise for vertical strips. The upper rail is mortised in exactly the same way.

D.- Brackets supporting shelf.

E.- Corner members, showing mortises and chamfer at upper and lower ends.

F.- Vertical strips.

The construction of this exercise is, apparently, simple, but its many joints that must be accurately fitted make it much more difficult than appears at first glance. The outline for its construction is as follows:

First:-

Make corner members (E).

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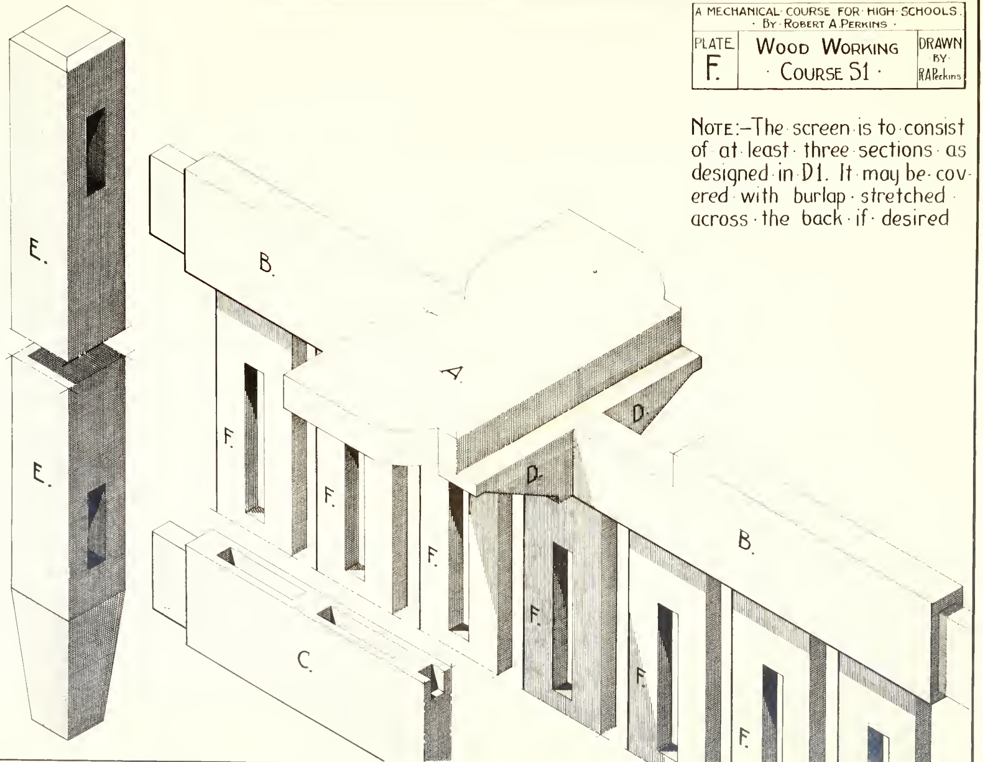
|---|---|---|
| PLATE F. | WOOD WORKING · COURSE S1 · | DRAWN · BY · R.A.Perkins |

NOTE:—The · screen · is · to · consist · of · at · least · three · sections · as · designed · in · D1. It · may · be · covered · with · burlap · stretched · across · the · back · if · desired



(a) These will be of square cross section and of dimensions indicated in student's design of Prob. 17, Dl. The ends will be chamfered as indicated.

(b) Let T equal thickness of rails (B) and (C),

W equal width of (B)

W' equal width of (C)

H equal distance between upper edge of (C) and lower edge of (B),

w equal width of vertical pieces (F),

t equal thickness of vertical pieces (F)

Then thickness of tenons equals T-1/4"

Width of tenons for (B) equals W-1/2"

Width of tenons for (C) equals W'-1/2"

Distance between lower edge of upper tenon and upper edge of lower tenon equals H+1", and,

Depth of mortises in (B) and (C) to receive vertical strips equals 3t/4.

Obtain the above dimensions by substitution.

(c) Make mortises of width T-1/4", length W-1/2", and depth three-fourths of width of (E) for upper rails (B). These are to be centrally located at a distance from the top equal to that shown in design.

(d) Make mortises of width T-1/4", length W'-1/2" and depth as for upper mortises. These are to be centrally located and are to be placed so that the upper face will be a distance H+1" from the lower face of the upper mortise.

Second:-

Make upper and lower rails. These should be laid out in pairs, i.e. should be cut to the same length and should be clamped together with ends flush when laying out mortises for vertical pieces (F) and the tenons securing them to the corner members (E). The length of these mortises will be w, width t, and depth 3t/4. The width of tenons will be W-1/2" for upper rails and W'-1/2" for lower rails. Their thickness will be T-1/4" and their length 3/4 the width of (E).

Third:-

Make vertical strips (F).

(a) These will be rectangular pieces of length H-1 1/2 t, and width w, and thickness t.

(b) The ornamental openings will be laid out upon both inner and outer faces of the strips; holes will then be bored at the upper and lower ends and the material between removed by sawing well within the lines; and, finally, the edges will be brought to line with a sharp chisel, working from both inner and outer faces.

Fourth:-

Make shelf and brackets (A) and (D) and fit same in exact center of upper rail of middle section of screen.

Fifth:-

Scrape and sand all surfaces, using extreme care to round none of the edges. Do not sand across grain.

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Sixth:-

Assemble and glue all joints. Square all corners and clamp firmly in place while glue is setting.

Seventh:-

Remove glue that has been forced from joints. Stain, fill, shellac and wax or varnish as preferred.

Eighth:-

Nothing has been said regarding the hinging of corners as this may be done with leather straps, allowing the sections to swing into any desired position, or they may be secured by mortised hinges, which allow adjustment in one direction only.

Ninth:-

Burlap may be stretched across the back face of the screen and attached to the upper and lower rails and corner posts by small strips and screws. This gives a very pleasing effect and affords a more perfect screen.

Plate G of Course S1.

The last three problems of Course S1 are taken from the suplementary problems of Course D1. The first, detailed in Plate G, is the drawing board and drawer, designed in Optional Prob. No. 1. The parts shown are:

A.- Top glued up of several sections, reinforced by strips rabbeted into adjacent pieces.

B.- End pieces secured by tongue and groove joints to A.

C.- End of cabinet.

D.- Frame work of bottom and drawer supports.

E.- Drawer front, showing blind dovetail, corner joint and handle.

F.- Bottom of drawer which fits into rabbet of sides and ends of drawer.

G.- Side of drawer, showing dovetail joint at corner. All corners are to be constructed in the same manner.

H.- Bottom of cabinet. This fits into rabbet made to receive it in the piece D.

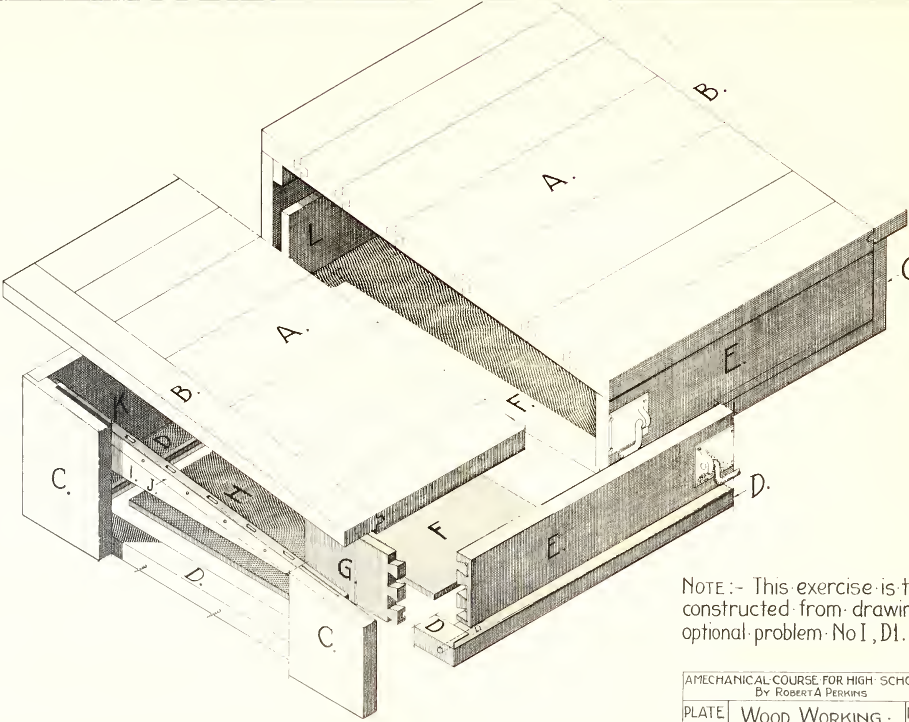
I.- Upper drawer guide.

J.- Birch strip secured to C by screws and glue. Screws passing through slots shown at the upper surface hold A in position.

K.- Back side of cabinet.

L.- Back side of drawer.

The outline of the construction is as follows:




NOTE:- This·exercise·is·to·be·constructed·from·drawings·of·optional·problem·No I, D1.

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|---|---|---|
| PLATE<br>·G· | WOOD WORKING·<br>·COURSE S1· | DRAWN<br>BY·<br>RA Perkins |

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First:-

Make ends of cabinet (C). The cabinet will be constructed of hard or soft wood as directed by the supervisor. The parts (A), however, will be of clear soft white pine.

(a) Lay out and cut to dimensions indicated in design made by the student in his Plate No.I D1. The grain of the wood is to run horizontally in the finished piece.

(b) Make blind dovetail joint at back corners. The construction of these joints is clearly shown in Plate B, S1, and its construction is explained in the accompanying text.

Second:-

Make back side of cabinet (K) of same wood as C with its grain running in the direction of the long dimension of the piece.

(a) Let L equal length of cabinet as taken from design
T equal thickness of sides, ends, etc.,
t equal thickness of blind and,
t' equal thickness of bottom pieces of cabinet and drawer.
Then length of K equals L-2t.
Determine this value by substitution. Remember that in substituting in formulas, all dimensions must be reduced to the same unit.

(b) Make rectangular pieces of length L-2t, width equal to C at its widest point, and thickness T.

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(c) Lay out dovetails and check with those of (c). Cut out and finish as explained in Plate B,Sl.

(d) Plane off top surface to correspond to slope of ends (c).

Third:-

Construct frame work (D) with corner construction as indicated.

(a) Make strip of thickness T, width 5T, and of length sufficient to make entire frame work with allowance for waste in making corners.

(b) Plow or cut with dado saw, a rabbet the entire length of piece; the depth of this to be 3t'/4 and its width t'.

(c) Cut two pieces of length L-2t and two pieces of length L'-T where L' equals length of the ends (C). Frame and fit corner joints as plainly indicated.

Fourth:-

Make bottom (E). This will be of length L-8T+1 1/2 t' and of width L'-7T+1 1/2 t'.

Fifth:-

Screw and glue the pieces (D) to the ends (C), making the bottom face of (D) exactly flush with the bottom edge of (C). The back end of (D) will fit in a distance T from the back edge of (C). Use hot glue for all construction.

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Sixth:-

Glue dowels into the parts (D) which were fastened to (C) in step 5.

Seventh:-

Insert the bottom (H) into the side pieces (D) of bottom frame work and, with glue upon the corner joints, fit, at the same time, the parts (D) and (H) together and clamp securely while glue is setting.

Eighth:-

Insert the back piece (K), clamping and gluing it to the ends (C) and frame work (D).

Ninth:-

Make top (A) of clear white pine with joints constructed as indicated. The rabbets may be made with plow or dado saw as most convenient.

(a) The length of the pieces (A) will be L-2T, total width of top L! and the thickness 1/4" greater than that of (B).

(b) Reduce the back edge of the upper piece of (A) to the thickness of (B) for a distance T in from the back face of (K).

Tenth:-

Make end strips (B) and secure to (A) by rabbet and tennon as indicated. The upper face of (B) is to finish exactly flush with that of (A).

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Eleventh:-

Glue and clamp the pieces (A) and (B). Scrape, sand and shellac.

Twelfth:-

Make birch strips (J) of thickness T and depth 1 1/4" at back end and tapered to 0 at the front edge. Keep at full width as far as possible without interfering with the side of drawer.

(a) Drill two holes closely together, in sets as indicated and of a diameter equal to shank of screws to be used in screwing the parts (J) to top (A). Cut out the material between the holes, thus forming a series of slots running vertically through strip.

(b) Attach these to top with screws only.

Thirteenth:-

Make the pieces (I) of thickness T and of the proper pitch so that when glued over the strips (J) a level guide will be afforded for the upper surface of the side of drawer.

Fourteenth:-

Place the top in position and drill several holes through the ends (C), into the pieces (J). The drill is to be of size of shank of screws, going through (C) and of considerably smaller diameter going through (J). Countersink for screw heads and drive all screws.

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Fifteenth:-

Take out the screws, remove the top, and glue and clamp (I) into its position upon (J).

Sixteenth:-

After glue has set in step 15, remove clamps, place a film of hot glue upon outer surface of (I) and (J), as well as along the upper edge of (K), and replace top and again drive screws into place. Clamp firmly at back edge until glue has set.

Seventeenth:-

Plant a molding in corner formed by (C) and (B) to cover screw heads. This molding is not shown, but may be either a quarter-round or cove.

Eighteenth:-

Construct the drawer. As no operations, not already explained, are involved, no detailed explanation of its construction should be necessary.

Nineteenth:-

Sand all surfaces. Use sand paper block, so that rounding of corners may be avoided. Do not sand across grain of wood.

Twentieth:-

Stain, fill and shellac or varnish, all except top which is to have shellac finish only.

Twenty-First:-

Attach handle at center of front face of drawer.

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<u>Plate H of Course S1.</u>

Plate H shows in detail the construction of the second optional problem of Course D1, which is that of designing a draftsman's stool.
The parts detailed are:-

A.- Seat, showing mortises for ends of legs, chamfer of upper edge, and slightly dished upper surface.

B.- Legs of stool, showing tenons for securing them to top, mortises for cross braces, and chamfer of edges. The manner in which lower ends are tapered is also shown.

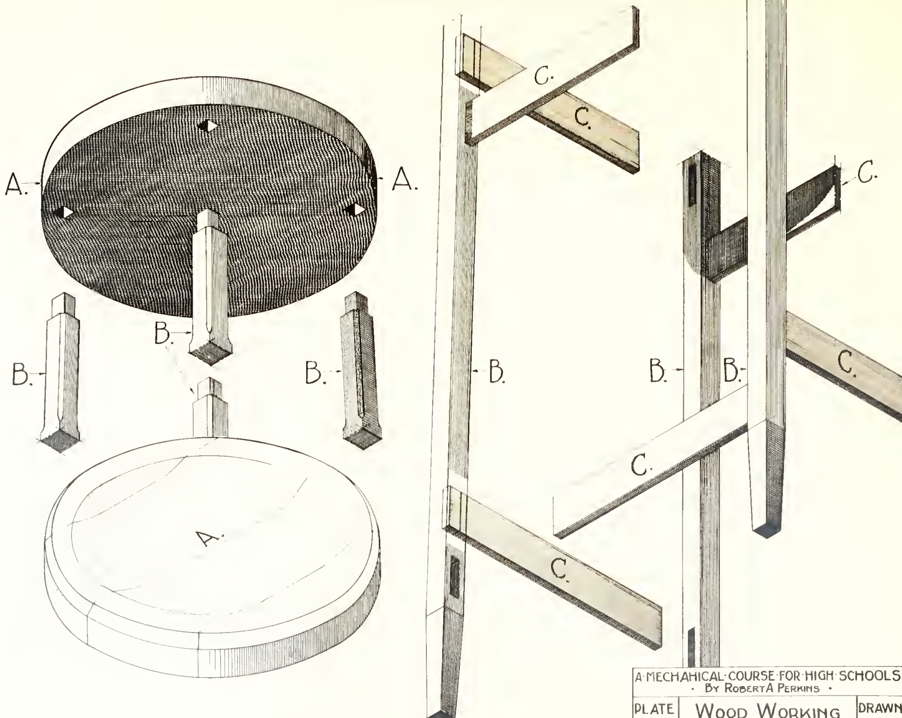
C.- Cross braces, showing manner in which they are staggered.

The outline of the steps to be taken in the construction of the stool is as follows:

First:-

Make top of stool of clear red oak, white oak or birch.

(a) Let T equal thickness of seat,
D equal diameter of seat,
H equal total height of stool, including seat,
t equal thickness of cross braces,
W equal width of cross braces, and
w equal width of faces of legs.
Then length of legs equals H-3/8"
Depth of mortises in seat equals T-3/8"
Depth of mortises in legs equals w-3/8"
Obtain above values by substitution.




Note:- Optional Problem No.2 Is Here Shown.

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| | | |
|---|---|---|
| Plate H. | Wood Working · Course S1 · | Drawn ·By· RA Perkins |

(b) Glue up the top of four pieces as indicated, the grain in each running longitudinally. The seat, as first glued together, should form a square of size D+1" and of thickness T.

(c) Dress to a smooth surface and lay out circles of outside edge, edge of chamfer, and line of dished portion.

(d) Saw out and finish to line, chamfer edge and work out dished portion. Of course, the quickest way to finish seat would be at the lathe, but, for this exercise, we prefer that all work be done by hand.

(e) Make mortises of depth T-3/8" and 1" square . (Note angle in second step.)

Second:-

Make the four legs (B) of clear red oak, white oak or birch.

(a) Make four pieces of length H+1/2" and of square section W. 7/8" is allowed for waste in cutting.

(b) At this point the only difficulties of the problem present themselves, viz. determining the angles of the various horizontal and vertical cuts. It will be noted that since the seat is horizontal and the floor upon which the stool stands is also horizontal, the upper end of the tenons and upper and lower ends of legs must be cut at an angle that will allow them to lie completely in these planes. It will further be noted that the legs, being further apart at the bottom than at the top, make

it necessary not only to have longer braces at the bottom of the stool than at the top, but also that the ends of braces be cut at such an angle as will permit them to enter the legs to an equal depth at all points. Finally, it will be noted that, since the braces are rectangular in cross section, and since their outer surfaces are placed parallel to the outer faces of legs, the upper and lower edges of mortises will be perpendicular to these outer faces. The mortises must be driven at the proper angle to accommodate these braces.

The determining of these angles will necessarily be an individual problem, dependant upon the student's design and will, therefore, be worked out graphically by each individual with the assistance of the instructor.

(c) Cut to length at the angle determined in (b). Make tenon of length 1-5/8", and of 1" cross section.

(d) Locate mortises for braces as in design. These are of width t, length W, and depth w-3/8" and are to be driven at the angle determined in step (b).

(e) Chamfer edges and cut taper at lower end of legs as indicated.

Third:-

Make braces. These are to be made of clear red oak, white oak, or birch. These will be of width W, thickness t. Their length must be determined by adding 2(w-5/8") to the apparent

length, taken from design, and by correcting for the angle determined in step (b) of the preceding section.

Fourth:-

Sand all surfaces. Do not round edges. Do not sand across grain of wood.

Fifth:-

Glue and clamp in assembled position.

Sixth:-

Remove any glue that may have been forced from joints by clamping.

Seventh:-

Stain, fill and varnish.

Plate I of Course S1.

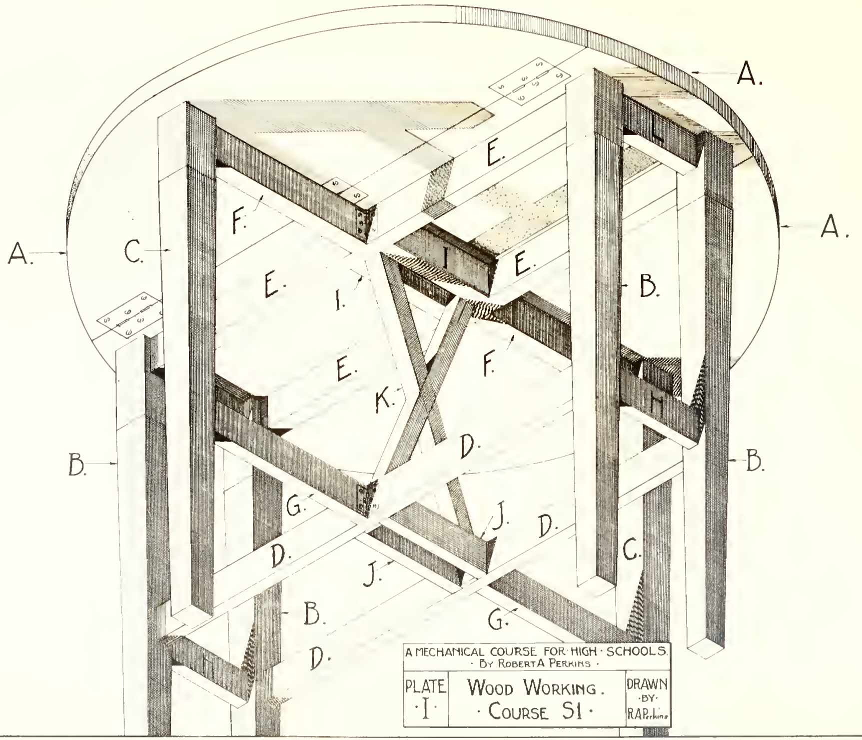
The last problem of Course S1 is presented in Plate I. It shows, to a fairly large scale, the important parts of the serving table, designed in Optional Prob. III, Course D1. The parts shown are:-

A.- Table top with two hinged leaves.

B.- Fixed legs of table.

C.- Swinging legs of table. These support the leaves when raised and may be swung back under the table when the leaves are lowered.

D.- Lower longitudinal braces.

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| PLATE ·I· | WOOD WORKING. · COURSE S1 · | DRAWN ·BY· R.A.Perkins |
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E.- Upper longitudinal braces and supports for top.

F.- Upper members, holding swinging legs in position.

G.- Lower members, holding swinging legs in position.

H.- Lower transverse braces.

I.- Upper middle transverse braces.

J.- Lower middle transverse braces.

K.- Cross braces. A single piece may be used as indicated in Shop Sketch of Optional Prob. III, if preferred.

L.- Upper transverse braces.

In constructing this table, the following brief outline will prove helpful. As there are no operations in the building of this problem, not already explained in previous problems, all descriptive details are omitted.

First:-

Make table legs (B) and (C). These may be made of a single piece or be glued up of several laminations of hard or soft wood, as directed by the supervisor. In making mortises, remember that outer faces of (D) and (H) must be in the same vertical plane. Why?

Second:-

Make braces (D) and (E). Note that the

pieces (D) are slightly longer than the pieces (E) and that the ends of (D) are cut at an angle slightly less than a right angle, due to the taper for the legs. These braces are to be made of same material as legs and secured to them by mortise and tenon joints.

Third:-

Make braces (L) and (H).

Fourth:-

Make braces (I) and (J). These will be secured to the longitudinal braces by dowelled joints. The dowels should not penetrate (D) and (E) to more than three-fourths of their thickness.

Fifth:-

Glue and clamp the parts (B), (D) and (E).

Sixth:-

After glue has set in the above operation, glue and clamp (L), (H), (I) and (J) to the parts already assembled. It will be necessary to insert these pieces at the same time.

Seventh:-

Make the cross braces (K) with half-lap joint at their common center, as indicated. Secure these in position between the parts (I) and (J) by gluing and by the use of screws, whose heads have been counter-sunk and covered.

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Eighth:-

Make braces (F) and (G) and secure them to the legs (C) by mortise and tenon joints. The tenons of (F) should be secured in position, in addition to gluing, by the use of dowels passing through the tenon and the sides of legs. These,being cut flush and finished with the leg, will not be noticeable.

Ninth:-

Hinge (F) and (G) to (D) and (E) as indicated.

Tenth:-

Make table top. This must be glued up of several sections, well jointed and carefully selected as to grain, color, etc. Glue up each of the leaves and the center portion as separate pieces and fasten them together, temporarily, by cleats tacked across their bottom faces. Lay out circle of top and with band saw, saw just outside the line. Finish to line, dress to an even surface and scrape. Hinge the three top sections as indicated. The wood used should be the same as for the remainder of table.

Eleventh:-

Sand all surfaces till clean and smooth. Use great care not to round corners and not to sand across grain of wood.

Twelfth:-

Stain and fill.

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Thirteenth:-

Attach top to the braces (E) and (L) by metal clips or angles.

Fourteenth:-

Varnish and rub to an egg shell gloss with pumice stone and oil.

A [illegible] LS.

BOOK V.

TABLE OF CONTENTS OF BOOK V.

COURSE S2.

LIST OF ILLUSTRATIONS
OF
COURSE 52.

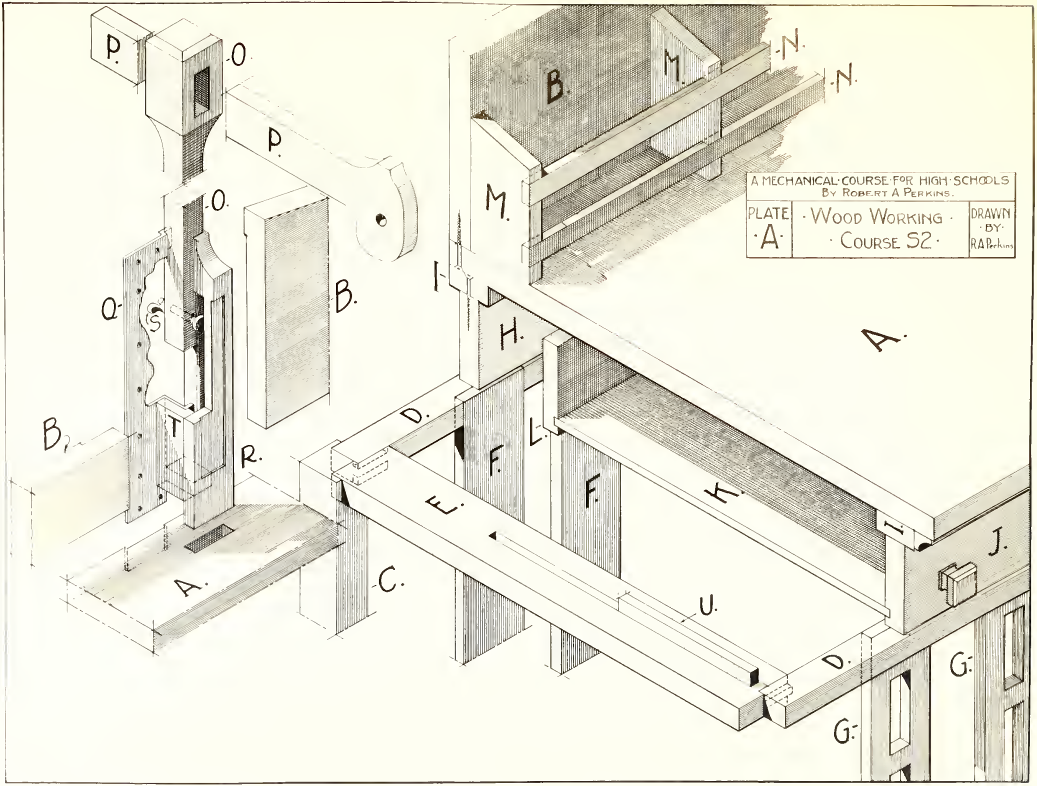
A Mechanical Course For High Schools.

WOOD WORKING.

Course S2.

Course S2 is to be considered simply a continuation of Course S1. The additional exercises for the course are to be a selection of any one of those shown in Plates A to E, included herewith, together with the cabinet designed in Plate III, D2. These two exercises must be most carefully executed, both in design and construction. Especial attention is to be given the processes of staining, filling and rubbing in order that the finish of the completed exercises will have a distinctly elegant appearance. No exercise showing carelessness in design or execution will be accepted for credit in this course.

The Plates, referred to above, detail the construction of the last three exercises of Course D1, regular and optional problems included, and the accompanying text is descriptive and explanatory of them.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A MECHANICAL·COURSE·FOR HIGH·SCHOOLS
BY ROBERT A PERKINS.
PLATE ·A·
·WOOD WORKING·
·COURSE S2·
DRAWN ·BY· RA Perkins

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Plate A, Course S2.

In Plate A, Course S2 the details of construction of the desk with light, designed in Prob. 18, D1, are shown isometrically projected. An explanation of the letters of reference follows:

A.- Desk top. This is to be glued up of several sections of a select hard wood, carefully matched as to color, grain, etc.; accurately jointed, glued and clamped; and finally, dressed, scraped and sanded to a smooth and even surface.

B.- Back of desk. This is made in two parts, if lamp is included in the design, and, of course, is one continuous piece if lamp is omitted. Each part will be cut away to receive the metal pieces ([illegible]) and will be secured to the table top with screws and glue as indicated.

C.- These will be mortised to receive the frame work of table as shown, and be secured at their upper ends to the side members (I), not shown, by mortice and tenon joints.

D.- Front and back frame work for drawer guides. The manner in which these pieces are secured to the legs, to the side frame (E), and to the vertical members (F) and (G) will be carefully noted.

E.- Drawer supports.

F.- Back vertical members supporting lower shelf. These will be set into shelf in exactly the same way as indicated in D and glued in position.

G.- Front vertical members. Similar to F with the exception that portions are cut away to lighten their appearance.

H.- Back of drawer cabinet. The sides of the cabinet will be constructed in exactly the same manner, each piece being secured to the legs by a mortise and tenon joint and to the parts D,E and I by the use of screws and glue.

I.- Top member of desk frame work. This member is to set flush with the back edge of top, but at the ends and front edge, the top will be allowed to overhang a distance sufficient to allow of a moulding being placed as indicated. As before stated, the legs will be secured to this member by mortise and tenon joints and the top by screws and glue.

J.- Drawer front, showing style of drawer pull and rabbet to receive bottom. Blind dovetail joints will be used at the front corners of drawer and simple dovetail joints at the back. (See Plates B and G, Sl.

K.- Drawer bottom.

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L.- Drawer back.

M-N.- Rack for holding stationery and letters. The pieces ([illegible]) will be secured to parts (A) and (D) by glued joints, reinforced by screws, driven from their lower and back faces, respectively.

O.- Sliding member of lamp.

P.- Lamp support. This passes through mortise in O, made to receive it with an exact sliding fit.

Q.- Metal guides. These will be made in the forge shop from patterns furnished by the student for whose desk they are to be used. The drawing shows clearly the manner in which these are bent to form guides for O, as well as the placing of counter-sunk screw holes for securing them to the parts (A) and (D).

R.- Front member of lamp standard. This will be mortised into the top (A) as indicated.

S.- Bolt for clamping O to the metal guide (Q).

T.- Side members of lamp standard.

U.- Drawer guide. This may be fitted in rabbet as indicated or may be glued into the corner formed by the members ([illegible]) and ([illegible]).

If the pupil desires to do so, the design of this exercise may be simplified, with the consent of the supervisor, by omitting the lamp.

Plate D, Course S2.

The details of construction of the table lamp designed in Prob. XIII,D1, are here shown, the parts detailed being as follows:

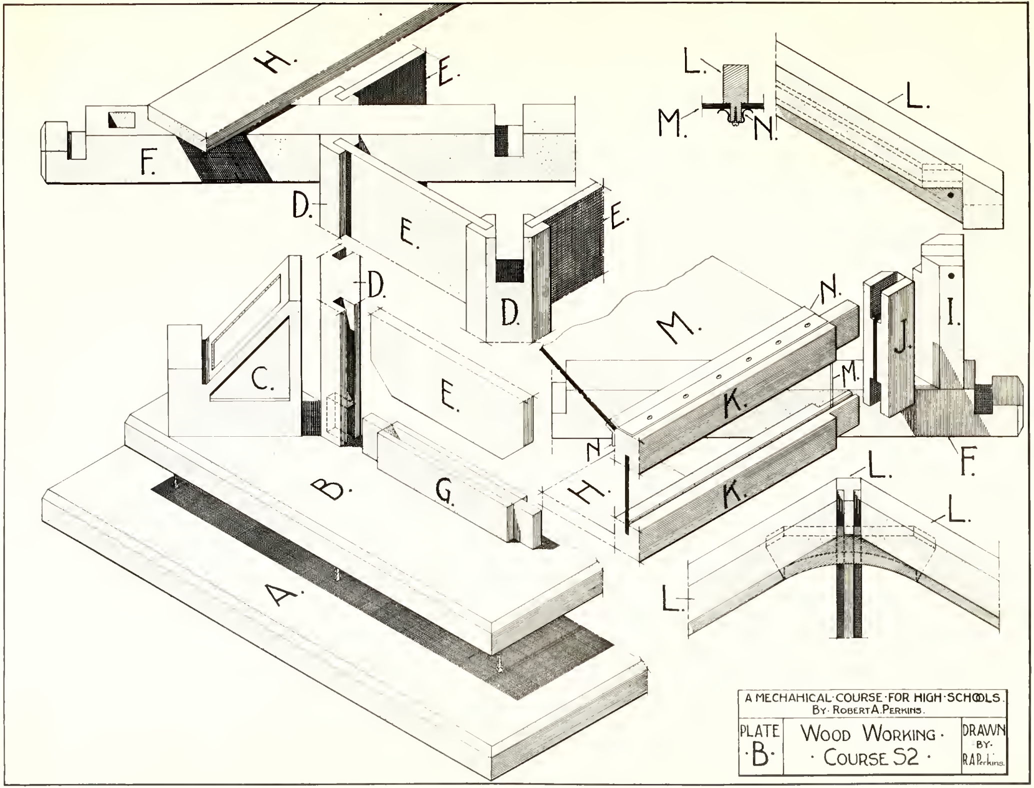
A.- Lower member of base. It will be noted that a thin strip with its upper edge chamfered at forty-five degrees is planted around the edge of the entire piece. This covers the end grain of (A).

B.- Upper member of base. This is of similar construction to that of (A) and is secured to it by screws and glue as indicated.

C.- Corner braces. Secured to (D) by screws and glue.

D.- Vertical corner members. These are complicated in form and difficult to make, for the angles formed by the various surfaces must be accurate in order that perfect joints with the lower rails (G) and the panels (E) may be secured.

E.- Panels. These should be glued up of from two to three laminations of veneering.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A MECHANICAL·COURSE·FOR HIGH·SCHOOLS.
BY· ROBERT A. PERKINS.
PLATE ·B·
WOOD WORKING·
·COURSE S2·
DRAWN ·BY· R.A.Perkins.

F.- Cross supports for shade, showing ornamental cut of ends, gain for half-lap joint at middle of cross supports, and mortise to receive the pieces (I).

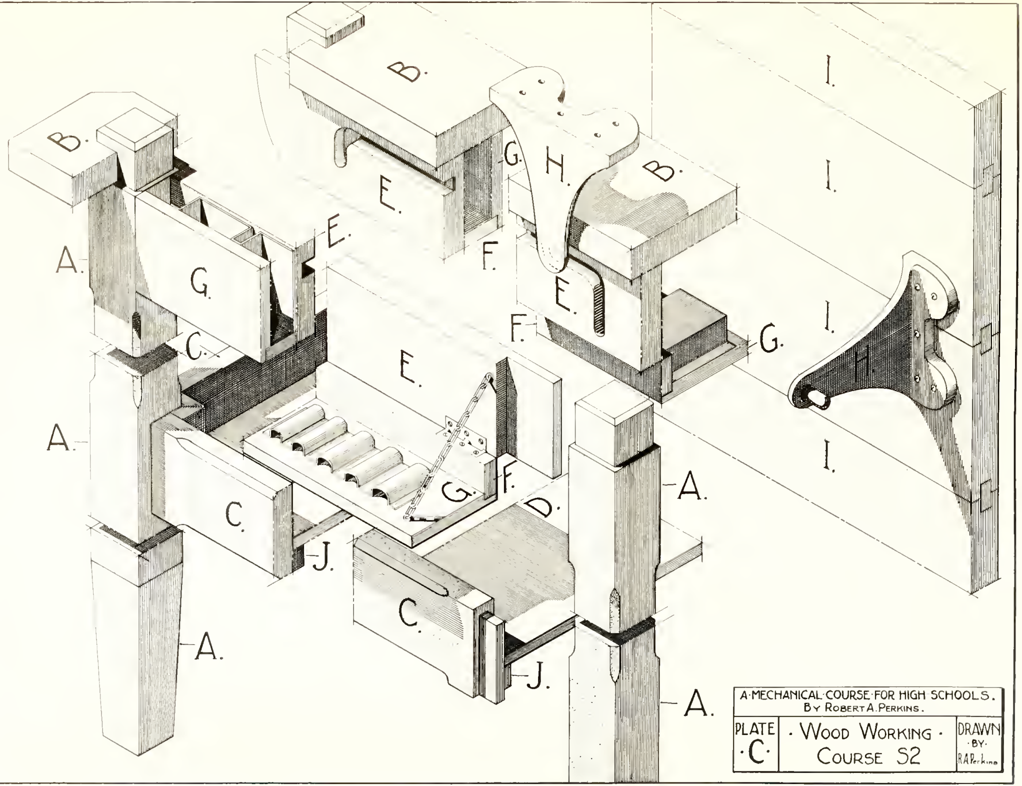
G.- Lower rail of panel. This is rabbeted to receive (E) and is secured to the corner members (D) by mortise and tenon joints. It will be seen that the corners of the panels (E) are cut at forty-five degrees to allow material to be left in (D) and (G), making such a joint possible.

H.- Lower member of lamp shade. The upper surface of this should be covered with bright metal to act as a reflector.

I.- Vertical corner members of shade. As before explained, these are secured to the cross supports (F) by mortise and tenon joints. The manner in which the upper ends of these pieces are to be mortised to receive the frame work (L) and drilled for the key, securing same in position, will be readily understood from the drawing.

J-K- Upper, lower, and end rails for art glass side panels, showing saw kerf for holding glass and the method of constructing corner joints.

L.- Frame for art glass top. The manner in which the two pieces, crossing at right angles are framed together at their point of intersection should be carefully studied as it is necessary that

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| | | |
|---|---|---|
| PLATE ·C· | · WOOD WORKING · COURSE S2 | DRAWN ·BY· R.A.Perkins |

this be a rigid joint. The manner of framing and keying the lower ends will also be observed. It is necessary, for replacing lamps etc., that the whole top should be removed and for this reason, corner joints secured by slip pins were decided upon.

L.- Art glass.

M.- Metal strips of various forms holding glass in position and forming a neat finish where it meets the wood frame work.

<u>Plate C, Course S2.</u>

In many respects the most difficult of all the exercises, herein offered, is the combination chair and table designed in Prob. XX,D1, and here shown in isometric detail. Not only must all the joints be fitted accurately, but the sliding parts must move freely and without interference as well as without lost motion. The parts shown in detail are as follows:

A.- Chair legs, showing chamfered corners, tapered lower ends, and large tenon with chamfered edges at upper ends. The length of these tenons must be sufficient to al-

low of their projecting above the upper surface of the arms to afford a support for the top and to provide clearance for the bracket (H).

B.- Arms of chair.

C.- Frame for seat, showing chamfered edges and tongue of mortise and tenon joints with legs.

D.- Wooden bottom to support cushion seat of chair.

E.- Inner cross brace. This shows the general form of the chase to be cut to receive metal lug of bracket, as it moves from its central to its end position. It also indicates the manner in which the piece is fitted to the legs (A). This joint will be glued and reinforced with round headed screws.

F.- Bottom member of arm pocket.

G.- Front member of arm pocket, showing sheet metal receptacles, location of hinges and chain. These will be held shut by a small catch fastened to (G) and slipping into a small slot in the lower face of (E).

H.- Metal bracket. The student should make the pattern for these pieces after which they should be cast of brass or made of malleable iron, finished and plated. These will be fastened to the top by round headed screws.

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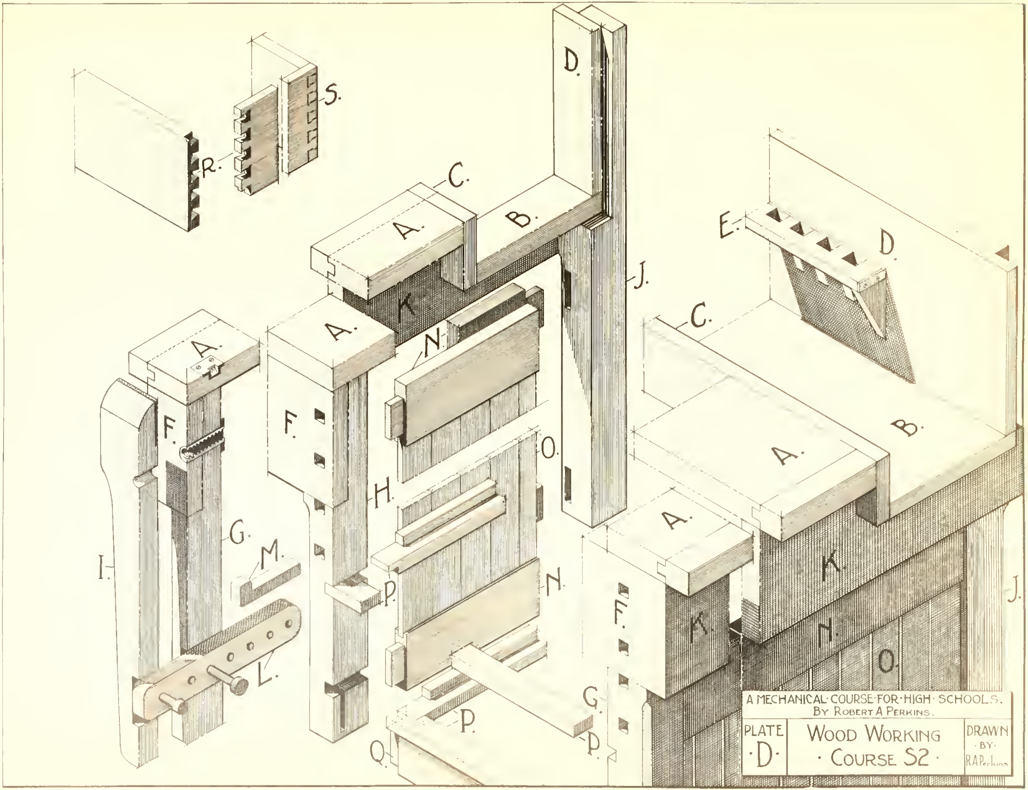
I.- Top construction. This is identical to that employed in several of the preceding exercises. The several parts of which this is constructed should be selected for color, grain, etc.; carefully glued and jointed; and finally, planed, scraped and sanded to a smooth and even surface. The side pieces of the top are not detailed, but they are to be glued in position as indicated in the small sketch of Plate X, D1.

The upholstering of the chair will, necessarily, be done under the personal direction of the instructor.

<u>Plate D, Course S2.</u>

The work bench, designed in optional problem IV, D1, is plainly detailed in this plate. An explanation of the letters of reference follows:

A.- Bench top. This should be constructed of 1 3/4" birch or maple, glued up of several sections with end pieces rabbeted, glued and screwed to ends as shown.


A MECHANICAL COURSE FOR HIGH SCHOOLS.
BY ROBERT A PERKINS.
PLATE
D
WOOD WORKING
COURSE S2
DRAWN BY RAPerkins
A
B
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B.- Bottom of tool trough.

C.- Side of tool trough.

D.- Back of bench

E.- Chisel and small tool rack. This is reinforced by a metal strip around its outer edge which is fastened to D and to its ends by small counter-sunk screws. It is further secured in position by small triangular braces.

F.- Apron of bench. This is gained into legs and secured to same by screws and glue.

G-J- End legs.

H.- Center legs.

(NOTE:- All the parts of bench, thus far mentioned, are to be secured in position by screws and glue. The screws are to be counter-sunk and are to have their heads covered by dowels driven in and finished flush with the various members.)

I.- Vise. The construction is plainly indicated. The screw with handle may either be made in the forge and machine shops or may be purchased at any hardware store.

J.- Rear legs. These are gained out to receive the parts (B) and (D).

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K.- Side supports of top pieces (A) and (B) and cross braces of bench. These pieces are mitred to (F) at the corners; are cut out for the trough formed by the parts (A), (B), (C), and (D) and are secured to the legs and the various other members as explained in the text, given above.

L.- Lower limb of vise. The steel pins and holes make possible adjustments for various thickness of material being clamped in the vise.

M.- Steel pins which are inserted in the holes, shown in the legs (G) and (H) and which support boards, one end of which is being held in the vise.

N.- Top and bottom rails of end panels, secured to legs by mortise and tenon joints and provided with rabbets for beaded ceiling panels.

O.- Beaded ceiling panels.

P.- Frame work of drawer guides, showing the manner in which the pieces are jointed at their ends and fitted into the legs.

Q.- Base board mortised into legs and secured to lower front member (F) by screws and glue.

R.- Front corner joint of tool drawers.

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B.- Back corner joint of tool drawers.

A rapid acting vise, Toles or equal, attached to one end of the bench is very convenient for small work and should be added where the student feels that he can afford to do so.

<u>Plate E, Course S2.</u>

The hall clock, designed in optional problem V, Course D1, is shown in isometric sectional elevation in Plate E; Figure 1, showing the construction of the cabinet; Figure 2, the base end; Figure 3, the detail of certain joints that will be enumerated in the following text. An explanation of the letters of reference follows:

A.- Top pieces. These slope to the front and side and are, therefore, mitred at an angle that must be determined for each design with the assistance of the instructor.

B.- PC moulding, concealing joint of (A) and (C), mitred at an angle of forty-five degrees at the corner.

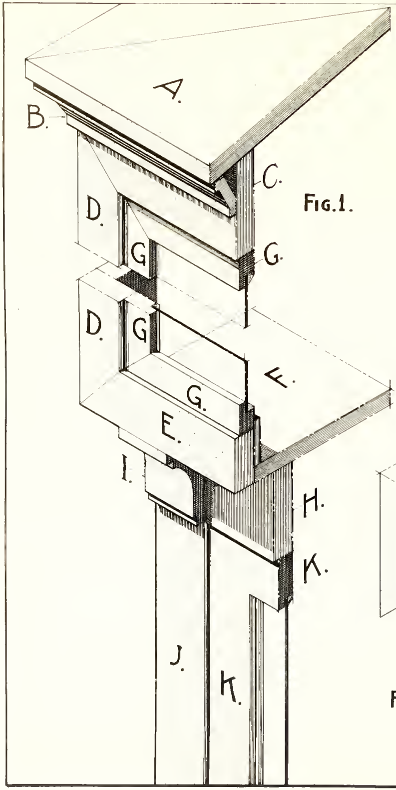


Fig.1.

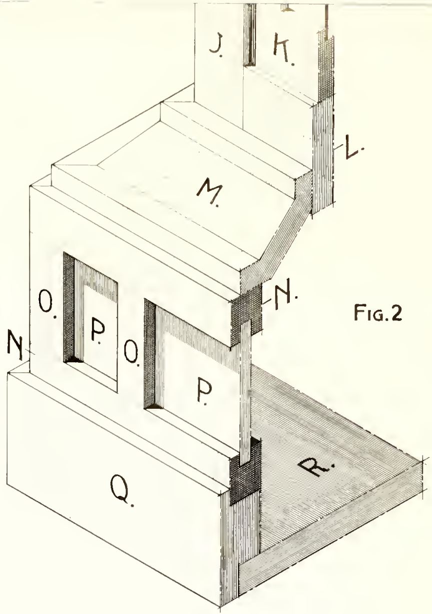


Fig.2

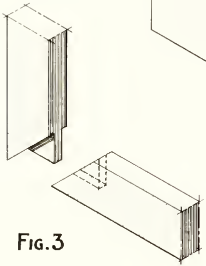

Fig.3

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|---|---|---|
| PLATE ·E· | Wood Working · Course S2 · | DRAWN BY· R.A.Perkins |

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C.- Upper members of clock cabinet. These are secured to (D) by joints similar to that shown in Fig. 5.

D.- Vertical members of clock cabinet. These are secured to (C) and (E) by joints similar to that shown in Fig. 5.

E.- Lower members of clock cabinet.

F.- Bottom of clock cabinet.

G.- Rails of upper door with corners joint- ed as in Fig. 5.

H.- Upper members of weight and pendulum case. These are secured to the corner posts (J) by mortise and tenon joints and to (F) by screws and glue.

I.- Bracket glued in position.

J.- Corner posts. These are secured to the parts (H) and (L) by tenons on the upper and lower ends of (J) fitting mor- tises provided in (H) and (L).

K.- Rails of lower door with corners joint- ed as shown in Fig. 5.

L.- Lower members of weight and pendulum case. These members are secured to the corner posts (J) by mortise and tenon joints.

M.- Large BG moulding of base.

N.- Upper and lower rails for panels of base. These are plowed to receive the panels and mortised to receive the vertical members (O).

O.- Vertical rails. These are rabbeted to receive the panels, have tenons securing them to the rails (N), and together with the ends of (Q), are mitred at forty-five degrees to form the corner joints.

P.- Panels. All panels must be glued up of two or more laminations.

Q.- Heavy base member, rabbeted to receive the rails (N) and the base (R) and mitred at the corners as indicated.

R.- Bottom board of base.

The dial, works, weights, chimes, etc., for the clock may be purchased in almost any grade and style from the manufacturer.

The final enterprise in Course D1 must be designed completely by the student with only such assistance as the instructor may see fit to give. Plate I of Course D2, with its accompanying text, offers a few suggestions that may prove helpful.